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TAXONOMIC REVISION OF
GERANIUM SECT. *POLYANTHA*
(GERANIACEAE)¹

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ABSTRACT

Geranium L. sect. *Polyantha* Reiche (Geraniaceae) consists of seven species. The highest diversity of the group is located in southwestern China with five endemic species. One species is found in the Himalaya, and another is located in the mountains of Burma. In contrast with some regional treatments, I have synonymized *G. ascendens* Z. M. Tan to *G. moupinense* Franch., and *G. platylobum* (Franch.) R. Knuth to *G. hispidissimum* (Franch.) R. Knuth. Micromorphological features of indumentum, pollen, and mericarps were investigated by SEM. The presence of pollen with *Erodium* L'Hér.-type exine ornamentation is confirmed for all species of the section. A new key is provided, as well as new and detailed descriptions. Each species is illustrated and mapped, and three lectotypes are designated.

Key words: Asia, Geraniaceae, Himalaya, monograph, morphology, taxonomy.

Geranium L. (Geraniaceae) is a genus of medium size with, at the present time, an estimated 325 species distributed throughout most of the world except lowland tropical areas. The difficulty of preparing monographic treatments of large genera is well known (Frodin, 2004) and applies to medium-sized genera as well. As part of an ongoing project to revise this genus worldwide, the initial strategy was to review sections or subgenera that were well characterized morphologically (Aedo, 1996, 2001, 2003; Aedo et al., 1998, 2002, 2003, 2005a, 2005b, 2007).

A complementary strategy has been to revise groups by geographical areas, for example, the species of the New World (Aedo, 2012) and those of the Pacific area (Aedo, 2016). Among the groups well characterized morphologically but not yet fully revised is *Geranium* subg. *Robertium* (Picard) Rouy. According to Yeo (1984), *Geranium* subg. *Robertium* is recognized by fruit discharge by carpel projection (see under Morphology) and may be divided into eight sections, distributed mainly in Macaronesia, the Mediterranean Basin, and the Himalaya. Among these,

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Geranium sect. *Batrachioidea* W. D. J. Koch and *Geranium* sect. *Divaricata* Rouy were monographed by Aedo et al. (1998), and *Geranium* sect. *Trilopha* Yeo by Aedo et al. (2016). *Geranium* sect. *Anemonifolia* R. Knuth and *Geranium* sect. *Ruberta* Dumort. were studied by Yeo (1973), and *Geranium* sect. *Lucida* R. Knuth and *Geranium* sect. *Unguiculata* (Boiss.) Reiche by Yeo (2004). Some work is still needed, however, to achieve a comprehensive monograph of these last four. The eighth section of the subgenus is *Geranium* sect. *Polyantha* Reiche, which is the subject of the present revision.

Reiche (1890) described *Geranium* sect. *Polyantha* as including three species: *G. polyanthes* Edgew. & Hook. f., *G. umbelliforme* Franch., and *G. tuberaria* Jacquem. ex Cambess.; the latter is currently classified into *Geranium* sect. *Tuberosa* Boiss. of the subgenus *Geranium* (Yeo, 1984; Aedo & Estrella, 2006). Knuth (1912) accepted three species in *Geranium* sect. *Polyantha*: *G. moupinense* Franch., *G. polyanthes*, and *G. umbelliforme*. However, the four additional species, *G. hispidissimum* (Franch.) R. Knuth, *G. strictipes* R. Knuth, *G. platylobum* (Franch.) R. Knuth, and *G. strigosum* Burm. f., are classified by Knuth (1912) into *Geranium* sect. *Palustria* R. Knuth. Yeo (1975, 1984) transferred *G. strigosum* to *Geranium* sect. *Polyantha* and synonymized *G. strigosum* to *G. strictipes* and *G. platylobum* to *G. hispidissimum*. In this work, the group is configured as it is currently understood.

Yeo (1992) recognized six species from southwestern China in the context of a revision of the genus for this area: the previously mentioned *Geranium polyanthes*, *G. umbelliforme*, *G. moupinense*, *G. strictipes*, *G. hispidissimum*, and *G. ascendens* Z. M. Tan. The latter, a species described by Tan (1990), is currently considered as a synonym of *G. moupinense* (Xu et al., 1998; Xu & Aedo, 2008). In their treatment of the genus for the *Flora Reipublicae Popularis Sinicae*, Xu et al. (1998) described *Geranium* sect. *Strigosa* C. C. Huang & L. R. Xu to separate *G. hispidissimum*, *G. strictipes*, and *G. platylobum* from *Geranium* sect. *Polyantha*, which was reduced to *G. polyanthes*, *G. umbelliforme*, and *G. moupinense*. The treatment of the genus for the *Flora of China* (Xu & Aedo, 2008) did not provide an infrageneric classification of *Geranium* and recognized five species for this group, synonymizing *G. platylobum* to *G. hispidissimum* and *G. ascendens* to *G. moupinense*. Consequently, an important part of the revision was already advanced (Yeo, 1992; Xu & Aedo, 2008). However, to obtain a comprehensive taxonomic treatment of the section, the two non-Chinese species should be included in the study and all species should be reevaluated.

Additionally, information about nomenclature, types, and descriptions should be updated and unified and maps and drawings should be provided.

Following my recent revisions of several groups of *Geranium*, and keeping in mind the goal of comprehensively monographing the genus, I present here a revision of *Geranium* sect. *Polyantha*.

MATERIALS AND METHODS

This revision is based on 164 herbarium specimens from the following herbaria: A, B, BM, C, CAS, E, G, GH, IBSC, JE, K, KUN, KYO, M, MA, MO, NY, P, PE, US, W, WRS�, and WU. An index of numbered collections is presented in Appendix 1.

Scored for the description of the species were 110 characters, 75 qualitative traits, and 35 quantitative traits, as well as seven ratios. At least 15 specimens were scored for each species. Quantitative characters were assessed with a Mitutoyo CD-15CD digital caliper (Mitutoyo, Kawasaki, Japan). The most frequent values are percentiles (between the 25th and 75th percentiles), which are shown without brackets, and the extreme values are enclosed in brackets. All measurements were taken from herbarium specimens. The line drawings of leaf laminas and petals show the adaxial surface unless stated otherwise. In the descriptions and key, the length of the sepal does not include the length of the mucro.

For SEM, samples were glued to aluminum stubs, coated with 40–50 nm of gold, and examined with a JEOL-TSM T330A (JEOL USA Inc., Peabody, Massachusetts) SEM at 15 kV.

MORPHOLOGY

All species of *Geranium* sect. *Polyantha* are perennial herbs with a more or less vertical rootstock. The stem is usually well developed, erect, or ascending and branched.

The following types of hairs have been detected in the species of *Geranium* sect. *Polyantha*. All of these hairs are simple and uniseriate (Theobald et al., 1979). According to Payne (1978), hairs 1 and 2 belong to the “subulate” type. The hair types are: (1) Short eglandular (0.1–0.3 mm), unicellular hairs, smooth or papillose, more or less uncinata (Fig. 1A); these occur in a variable frequency in all species, mainly in the inflorescences. (2) Long eglandular (0.2–3.3 mm), unicellular hairs, smooth or papillose, patent (Fig. 1B); these occur in a variable frequency in all species, at least in the inflorescences. (3) Glandular hairs with a foot consisting of cylindrical or decussate cells (Fig. 1C); these occur in all species on almost all structures of a plant. (4) Plane,

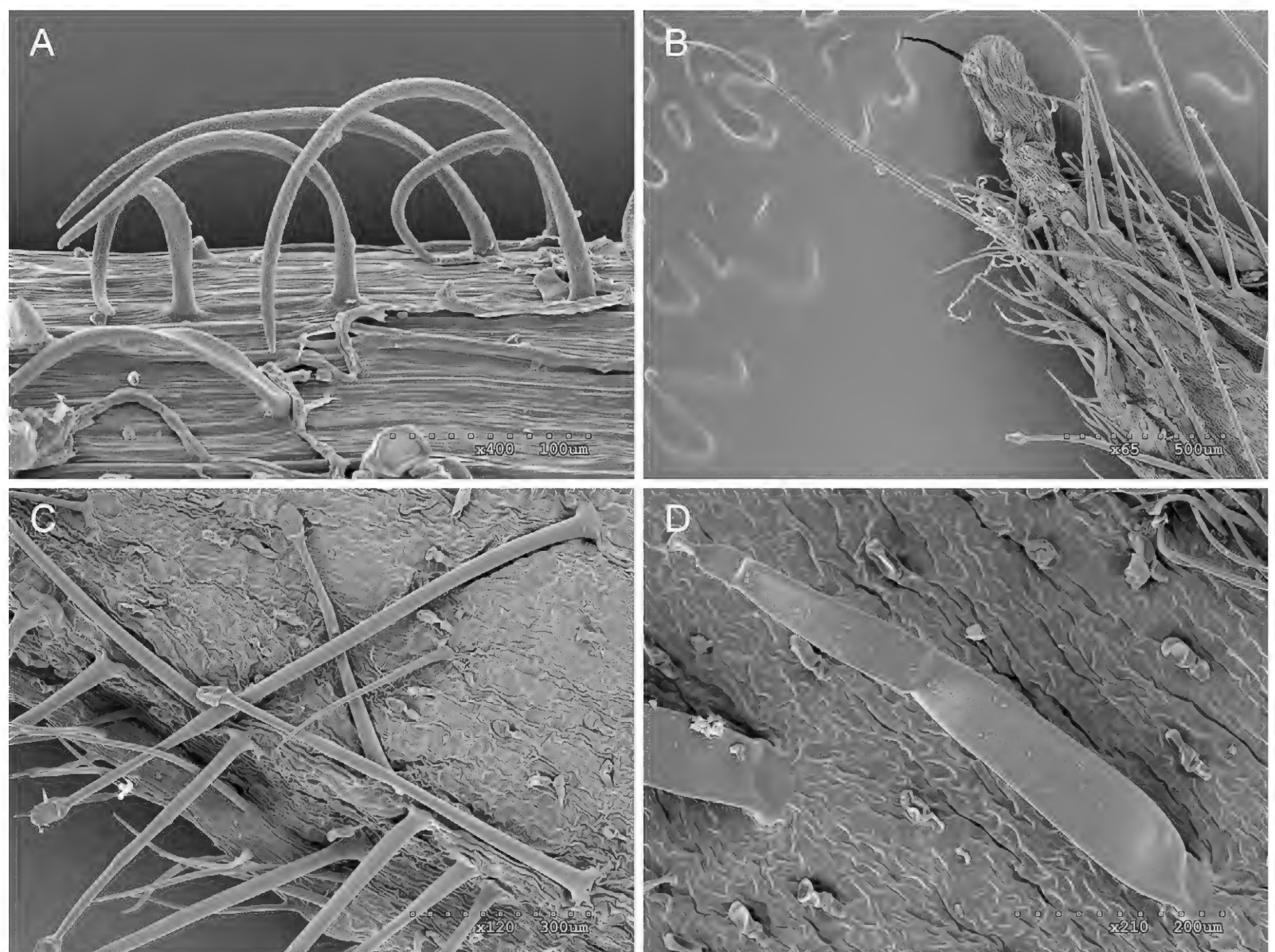


Figure 1. SEM photographs showing hair types found in *Geranium* L. sect. *Polyantha* Reiche. —A. Peduncle of *G. strictipes* R. Knuth showing short eglandular, uncinulate hairs (*D. E. Boufford et al.* 33029, MA). —B. Sepal adaxial surface of *G. polyanthes* Edgew. & Hook. f. showing long eglandular hairs (*Gaoligong Shan Biodiversity Survey* 32158, CAS). —C. Sepal adaxial surface of *G. polyanthes* showing long glandular hairs (*Gaoligong Shan Biodiversity Survey* 32158, CAS). —D. Leaf adaxial surface of *G. nakaoanum* H. Hara showing plane, glandular hairs (*F. Miyamoto* 9410140, E).

glandular hairs (0.4–1 mm), with two to four cells, usually papillose (Fig. 1D); these are restricted to the adaxial surface of the leaves in *G. nakaoanum* H. Hara and to both surfaces in the remaining species of *Geranium* sect. *Polyantha*. This feature, which is shared by other species of *Geranium* subg. *Robertium*, does not occur in either *Geranium* subg. *Geranium* or *Geranium* subg. *Erodioidea* (Picard) Yeo. (5) Short glandular hairs (< 55 μ m), smooth, usually of two cells, but sometimes with a bicellular foot, and present in all species studied here. Because these are evident only at high magnification, they are not included in the descriptions.

The primary division of the leaf is referred to as a “segment”; subsequent divisions are called “lobes.” The basal leaves are usually arranged in a more or less deciduous rosette. Cauline leaves are usually similar in shape to the basal leaves, although they become progressively shorter toward the shoot apex. All species have palmatifid leaves (with the divisions over the middle), polygonal in outline and with five

segments. The leaves of *Geranium favosum* Hochst. ex A. Rich., *G. moupinense*, and *G. nakaoanum* are more deeply divided, with divisions of over three quarters. Leaves of *G. hispidissimum*, *G. strictipes*, *G. wardii* Yeo, and, usually, *G. nakaoanum* are opposite. In *G. polyanthes* and *G. umbelliforme*, the middle cauline leaves are alternate, but the more distal ones are opposite. Finally, only alternate leaves occur in *G. moupinense*. Each leaf has two free stipules, one on each side of the petiole base. The stipules are lanceolate in *G. hispidissimum* and *G. strictipes*, broadly lanceolate in *G. moupinense*, and ovate and obtuse in the remaining species of the section.

The cymules are arranged in a dichasial cyme with monochasial branches in *Geranium hispidissimum*, *G. strictipes*, and *G. wardii*, while in the remaining species the cymules are in a monochasial cyme. *Geranium nakaoanum* has cymules usually 1-flowered. *Geranium polyanthes* and *G. umbelliforme* have part of their cymules grouped in umbel-like aggre-

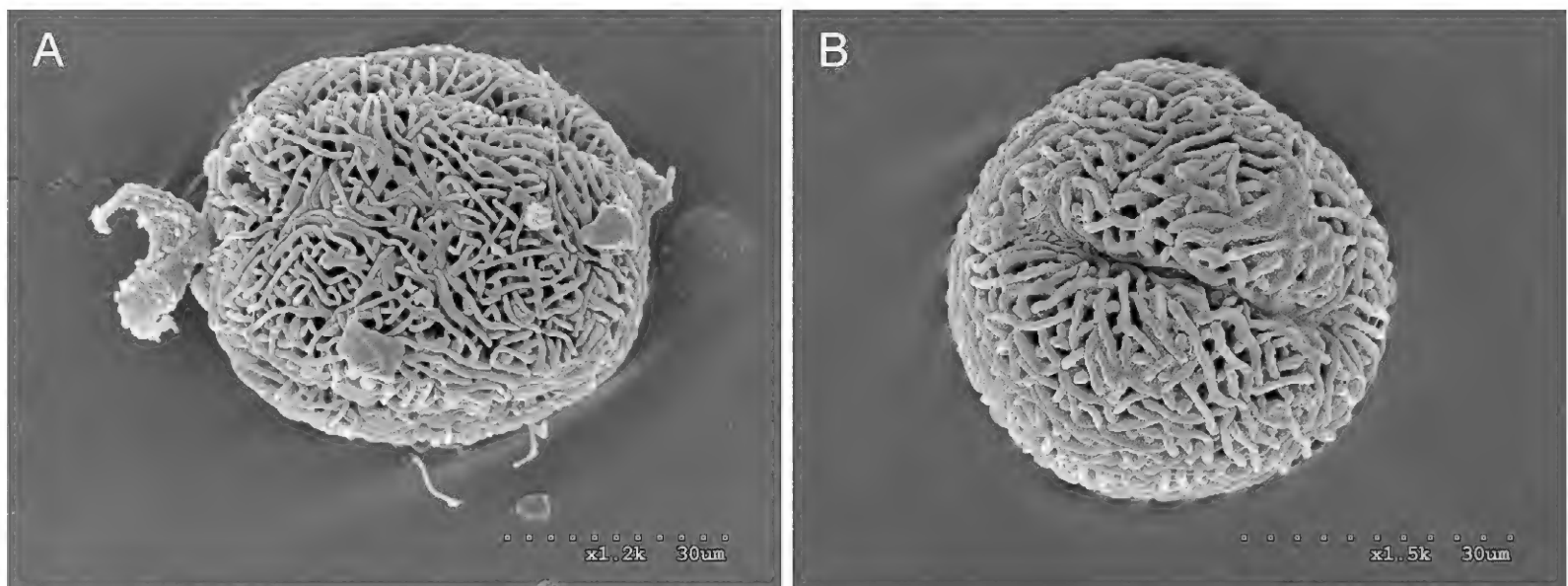


Figure 2. SEM photographs showing pollen grains of *Geranium* L. sect. *Polyantha* Reiche. —A. Pollen grain of *G. moupinense* Franch. (A. David s.n., MA-628480). —B. Pollen grain of *G. nakaoanum* H. Hara (F. Miyamoto 9410140, E).

gates at the top of each branch (usually with more than two flowers per cymule), while the remaining species always have solitary and 2-flowered cymules.

The five sepals form a quincuncial calyx. The two inner sepals are usually smaller and less pubescent than the others. The external surface of each sepal is smooth. The sepals of each species terminate in a distinct mucro.

The five petals are erect-patent, usually with an entire apex and without claw. The petal color is usually purple without any dark basal spots. The petal length is of taxonomic utility to differentiate *Geranium strictipes* from *G. hispidissimum*, the latter having shorter petals. The petals of *G. moupinense*, *G. strictipes*, and *G. umbelliforme* are hairy toward the base on both surfaces and ciliate on the basal margin; in the remaining species petals are usually glabrous on the abaxial surface.

The flowers of *Geranium* sect. *Polyantha* have two whorls of five fertile stamens. The stamens are shorter than the petals. The anthers are dorsifixed and dehisce by longitudinal slits. The filaments are lanceolate, except in *G. nakaoanum*, which has an abruptly narrowed apex. They are hairy on the proximal half and with cilia on the margin.

The pollen of *Geranium* is tricolpate and more or less isodiametric. In most species the exine bears reticulate ornamentation formed by baculate, clavate, or gemmate supratectal elements (Bortenschlager, 1967; Stafford & Blackmore, 1991; Weber, 1996). However, in the species of *Geranium* sect. *Trilopha* (Aedo et al., 2016) and *Geranium* sect. *Polyantha*, the exine shows a striate-rugulose pattern, similar to that found in *Erodium* L'Hér. (Bortenschlager, 1967; El-Oqlah, 1983). It has been confirmed that the pollen of all species of *Geranium* sect. *Polyantha* is of the *Erodium*-type (Fig. 2). This supports the close

relation between *Geranium* sect. *Polyantha* and *Geranium* sect. *Trilopha*, which should be explored more deeply, together with a comprehensive revision of all groups of *Geranium* subg. *Robertium*.

Five hemispheric nectaries are located to the base of and alternate with the petals; they are glabrous in *Geranium nakaoanum*, *G. polyanthes*, *G. umbelliforme*, and *G. wardii*, while in the remaining species they have a tuft of hairs at the top.

The gynoecium comprises five carpels, each with two ovules, of which only one develops into a mature seed. The five styles are fused into a column, divided at the apex into five branches, each of which has a stigmatic surface on the adaxial side.

The type of fruit discharge was the basis for the subgeneric classification of *Geranium* proposed by Yeo (1984). *Geranium* subg. *Erodioidea* is characterized by the “*Erodium*-type” of discharge, in which the entire mericarp, including the coiled awn, is propelled over a short distance. *Geranium* subg. *Geranium* is characterized by the “seed-ejection type” of discharge, in which each single seed is launched by the explosive recurvature of the awn. *Geranium* subg. *Robertium* has a “carpel-projection type” of discharge: the whole mericarp, containing the seed, is dispersed by the propelling force of the explosive recurvature of the awn. The species of *Geranium* sect. *Polyantha* show a discharge of the “carpel-projection type.”

The five carpels of *Geranium* form a syncarpous-lobed ovary maturing into a schizocarp. After fertilization a prominent rostrum develops next to the style. At maturity the carpel shows two parts: (1) a locus containing the seed, named mericarp, and (2) a sterile portion forming a ribbon-like band, which constitutes the rostrum. In some species of *Geranium* the rostrum is gradually narrowed toward the apex, whereas in others it terminates abruptly in a narrow

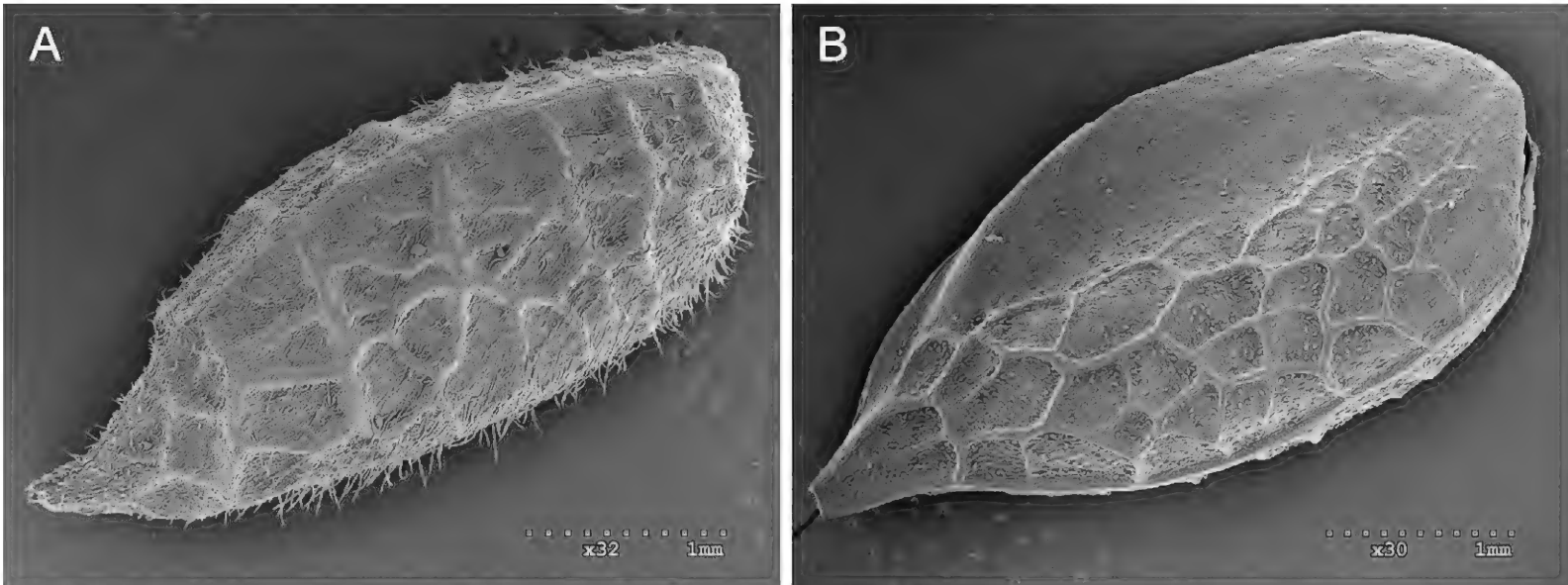


Figure 3. SEM photographs showing mericarps of *Geranium* sect. *Polyantha* Reiche. —A. Lateral view of the mericarp of *G. hispidissimum* (Franch.) R. Knuth (*T. T. Yü 1541*, GH). —B. Lateral view of the mericarp of *G. nakaoanum* H. Hara (*J. H. Haas 2118*, BM).

apex, in which case the apical portion of the rostrum is easily differentiated from the basal portion. Only three species of *Geranium* sect. *Polyantha* (*G. moupinense*, *G. strictipes*, and *G. umbelliforme*) have a well-developed narrowed apex. The five ribbon-like bands of the rostrum are parallel in *Geranium* sect. *Polyantha*. In contrast, in the species of *Geranium* sect. *Trilopha* the rostrum is twisted. The mericarps in *Geranium* sect. *Polyantha* have a slightly reticulate surface and have short eglandular hairs, with the exception of *G. nakaoanum*, which has glabrous mericarps (although some minute glands can be observed at high magnification) (Fig. 3).

The seeds are more or less ellipsoid and slightly compressed. The outer layer of the seed coat has cells with anticlinally thickened walls, forming a finely reticulate surface.

TAXONOMIC TREATMENT

Geranium* sect. *Polyantha Reiche in Engl. & Prantl, Nat. Pflanzenfam. 3(4): 8. 1890. TYPE: *Geranium polyanthes* Edgew. & Hook. f.

Geranium sect. *Strigosa* C. C. Huang & L. R. Xu, Fl. Reipubl. Pop. Sin. 43(1): 47. 1998. TYPE: *Geranium strictipes* R. Knuth.

Perennial herbs. Leaves palmately divided; cauline leaves opposite or alternate; stipules free. Inflorescence in monochasial cyme or dichasial cyme with monochasial branches. Flowers actinomorphic. Sepals lanceolate, erect, not accrescent. Petals usually rounded at

apex, without claw, without basal spot. Stamens not exerted; filaments pilose; pollen of *Erodium*-type. Fruit discharged by carpel projection, each mericarp thrown off explosively with seed in it and awn dropping away at moment of explosion; mericarps reticulate, without basal callus, without basal prong, without strand of fibers, hairy; rostrum not twisted distally. Cotyledons entire.

Distribution and habitat. *Geranium* sect. *Polyantha* occurs from Eastern Himalaya to southwestern China and Burma. The richest areas are the Chinese provinces of Yunnan and Sichuan.

Discussion. *Geranium* sect. *Polyantha* is a group of perennial herbs, well characterized by petals without a basal spot, sepals not accrescent, and pollen of *Erodium*-type. Its fruit has a “carpel-projection type” discharge, as well as reticulate mericarps and a rostrum not twisted distally. *Geranium hispidissimum*, *G. strictipes*, and *G. wardii* share an inflorescence with a dichasial structure and opposite leaves. In contrast, the group comprising *G. polyanthes*, *G. umbelliforme*, and *G. moupinense* has a monochasial inflorescence and alternate leaves (at least in the middle of the shoot). *Geranium nakaoanum* is somewhat intermediate, having a monochasial inflorescence but leaves usually opposite. This species is also the only one in the section showing some other features, e.g., usually 1-flowered cymules, scarce indumentum, and staminal filament shape.

KEY TO THE SPECIES OF *GERANIUM* SECT. *POLYANTHA*

- 1a. Cymules in umbel-like aggregates at the top of each branch.
- 2a. Cymules 2(or 3)-flowered, in dense umbel-like aggregates at apex of each branch, usually without peduncle; rostrum without narrowed apex (sometimes up to 1 mm); petals (7.8)9.3–11.8(14.1) mm..... 4. *G. polyanthes* Edgew. & Hook. f.

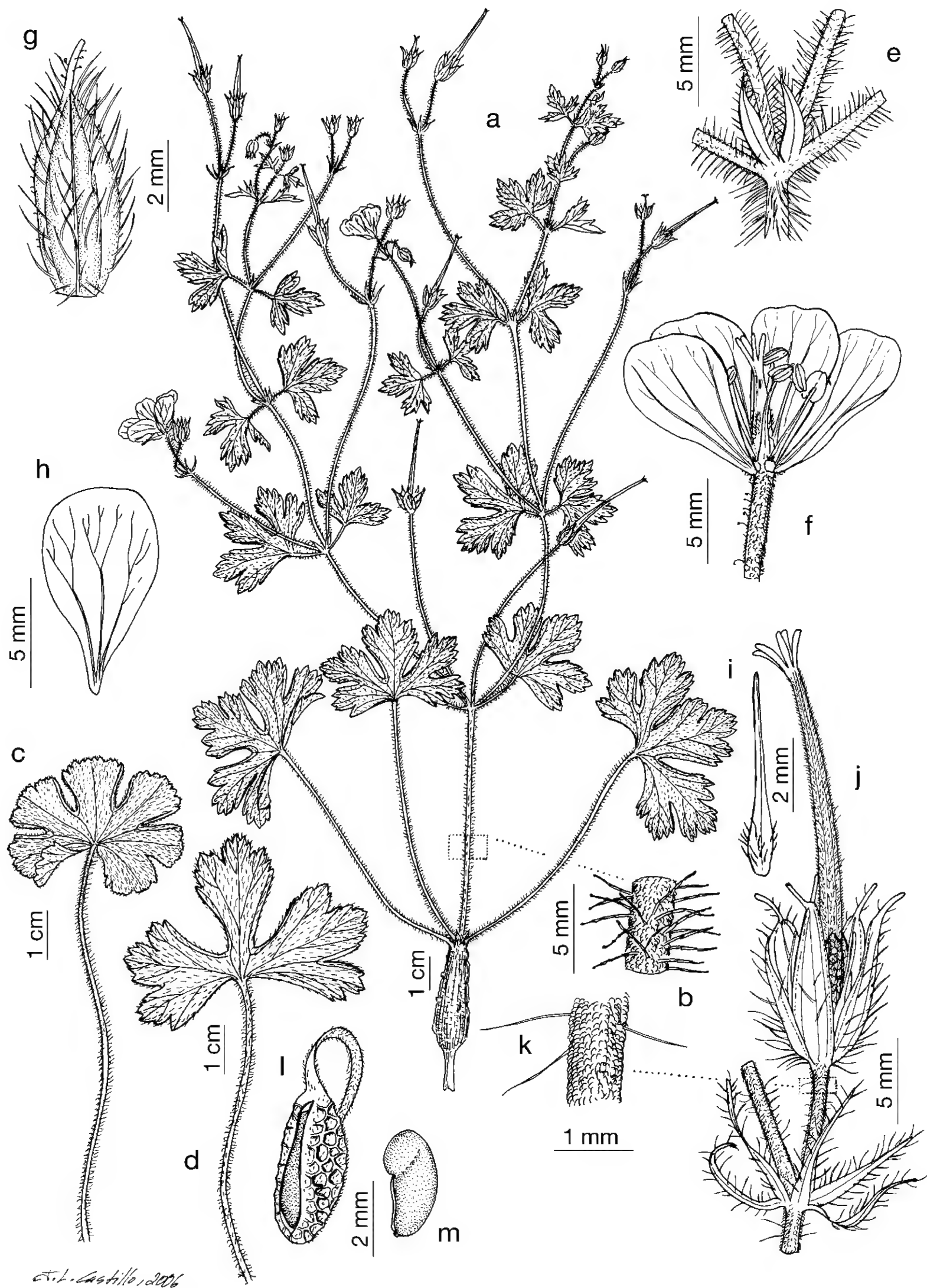


Figure 4. *Geranium hispidissimum* (Franch.) R. Knuth. —A. Habit. —B. Stem indumentum. —C, D. Leaves. —E. Stipules. —F. Flower without sepals. —G. Sepal. —H. Petal. —I. Staminal filament. —J. Fruit. —K. Peduncle indumentum. —L. Mericarp. —M. Seed. A–D, F–H, L, M based on *Qin* 23372 (PE); I–K based on *E. E. Maire* 2577 (E); E based on *E. E. Maire* s.n. (E-216867).

- 2b. Cymules (2- or)3- or 4-flowered, in loose umbel-like aggregates at apex of each branch with peduncles 25–67 mm; rostrum with narrowed apex 2–2.1 mm; petals (13.1)13.8–15.2(16.8) mm 6. *G. umbelliforme* Franch.
- 1b. Cymules solitary.
- 3a. Cymules 1(or 2)-flowered; stem glabrous 3. *G. nakaoanum* H. Hara
- 3b. Cymules 2-flowered; stem $\pm$ hairy 4
- 4a. Basal cauline leaves alternate 2. *G. moupinense* Franch.
- 4b. Basal cauline leaves opposite.
- 5a. Leaf deeply divided (ratio of main sinus length:segment length = [0.70]0.80–0.86[0.89]) 5. *G. strictipes* R. Knuth
- 5b. Leaf not deeply divided (ratio of main sinus length:segment length = [0.55]0.68–0.77[0.81]).
- 6a. Petals (8.6–)9–9.8(–10.6) mm; nectaries hairy at the top; sepal mucro 0.8–2.4 mm; middle segment of the leaf with 9 to 16 lobes 1. *G. hispidissimum* (Franch.) R. Knuth
- 6b. Petals 12.6–13.4 mm; nectaries glabrous; sepal mucro 1.1–1.2 mm; middle segment of the leaf with 7 to 8 lobes 7. *G. wardii* Yeo

1. *Geranium hispidissimum* (Franch.) R. Knuth in Engl., Pflanz. IV. 129 (Heft 53): 183. 1912. *Geranium strigosum* var. *hispidissimum* Franch., Pl. Delavay. 113. 1889. TYPE: China. Yunnan: ad collum montis Hee-chan-men, 26°06'N, 99°57'E, 15 July 1887, *P. J. Delavay s.n.* (lectotype, designated by Yeo [1992: 199], P!; isoelectotype, B destroyed, K!, LE). Figure 4.

Geranium strigosum var. *platylobum* Franch., Pl. Delavay.: 113. 1889. *Geranium platylobum* (Franch.) R. Knuth in Engl., Pflanz. IV. 129 (Heft 53): 183. 1912. TYPE: China. Yunnan: montis Che-tcho-tze, supra Tapin-tze, 25°34'N, 100°14'E, 6 Aug. 1887, *P. J. Delavay 2756* (lectotype, designated by Kunth [1912: 183], P!; isoelectotype, K!).

Perennial herbs, 16–72 cm. Stem erect or ascending, leafy, with uncinat, eglandular hairs 0.1–0.3 mm, patent, eglandular hairs 0.5–3.3 mm (sometimes lacking), and patent, glandular hairs 0.3–3.5 mm. Basal leaves in a $\pm$ persistent rosette, cauline leaves opposite; leaf laminae (2.4)3.5–4.4(5.3) $\times$ 3.2–8.4 cm, palmatifid (ratio of main sinus length:middle segment length = [0.55]0.68–0.77[0.81]), polygonal in outline, base cordate, pilose, with $\pm$ appressed, eglandular hairs and plane, glandular hairs on both surfaces; segments 5, middle segment obtriangular, 4.8–11.7 mm wide at base, 9- to 16-lobed in distal half; petioles up to 15 cm, with uncinat eglandular hairs 0.1–0.3 mm, patent, eglandular hairs 0.4–3.1 mm (sometimes lacking), and patent, glandular hairs 0.4–3.2 mm; stipules 3.9–13.2 $\times$ 0.9–3.1 mm, lanceolate, free, green, with scattered eglandular hairs on abaxial surface and margin, glabrous adaxially. Inflorescence a dichasial cyme with monochasial branches; cymules 2-flowered, solitary; peduncles (11)69–129(145) mm, with uncinat, eglandular hairs 0.1–0.3 mm, patent, eglandular hairs 0.5–3.2 mm (sometimes lacking), and patent, glandular hairs 1.2–2.4 mm; bracteoles 4.5–6.6 $\times$ 0.5–1.1 mm, lanceolate, whorled; pedicels (8.1)0.3–22(31.8) mm, with uncinat, retrorse eglandular hairs 0.1–0.3 mm, patent,

eglandular hairs 0.2–2.2 mm (sometimes lacking), and patent, glandular hairs 0.6–2 mm. Flowers actinomorphic. Sepals (4.9)5.2–6.4(7.3) $\times$ 2.1–3 mm, lanceolate, smooth, not accrescent, with mucro 0.8–2.4 mm (ratio of mucro length:sepal length = 0.17–0.35), with $\pm$ patent, eglandular hairs 0.1–0.5 mm and patent, glandular hairs 1–3.4 mm on abaxial surface, glabrous adaxially. Petals (8.6)9–9.8(10.6) $\times$ 3.9–7.3 mm, erect-patent, entire, without claw, white to purple, hairy on base of adaxial surface, usually glabrous on abaxial surface, ciliate on basal margin. Staminal filaments 3.8–5.1 mm, lanceolate, white, pilose on abaxial surface, ciliate on proximal half, with hairs 0.2–0.9 mm; anthers 1.2–1.7 mm, unknown color. Nectaries 5, hemispheric, with a tuft of hairs at top, dorsally glabrous. Gynoecium 3.1–5.9 mm, pink. Fruit 23–28 mm; mericarps 3.7–4.7 $\times$ 1.2–1.8 mm, reticulate, brown, with $\pm$ appressed, eglandular hairs 0.1–0.2 mm; rostrum 16–20 mm, without narrowed apex or with narrowed apex 0.5–1 mm, with patent, eglandular hairs 0.1–0.2 mm and patent, scattered, glandular hairs 0.1–0.7 mm; stigmatic remnants 1.5–2.4 mm, with 5 glabrous lobes. Seeds 2.2–3.3 $\times$ 1–1.5 mm, smooth, brown. Chromosome number not known.

Additional illustrations. Tan (1991: 35, tab. 9, fig. 7, sub *Geranium platylobum*; 37, tab. 10, figs. 1–3); Wu and Chen (1991: 86, tab. 25, figs. 1–2; 5, sub *G. platylobum*); Xu et al. (1998: 49, tab. 13, figs. 1–6, sub *G. platylobum*).

Phenology. *Geranium hispidissimum* has been collected in flower from May to November.

Distribution and habitat. *Geranium hispidissimum* is present in Sichuan and Yunnan Provinces in southwestern China, in meadows, among shrubs in open rocky slopes, and in forest edges of pines or of mixed deciduous broad-leaved evergreen and conifers. This species is found at altitudes of 2000–3200 m. Figure 5.

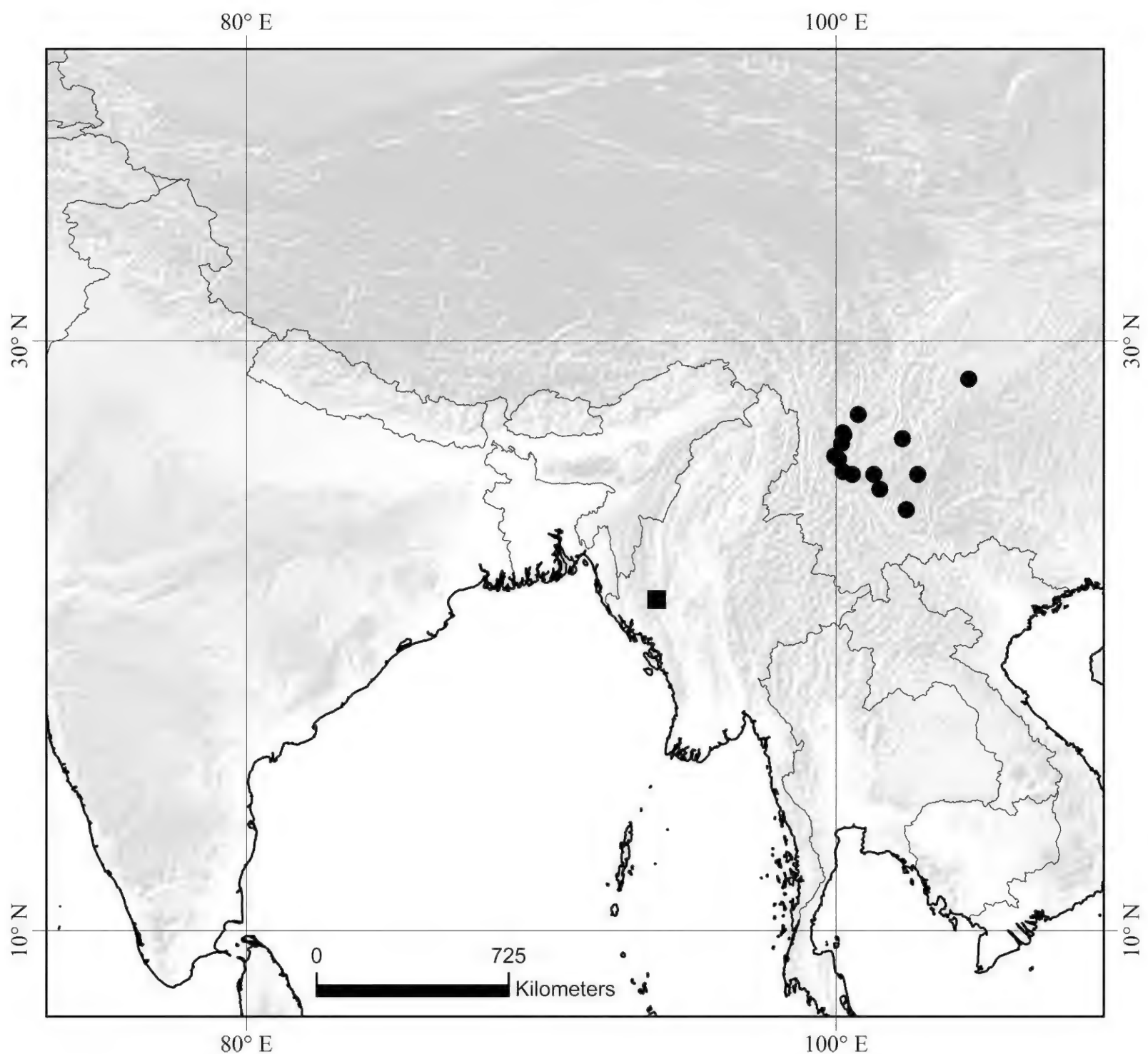
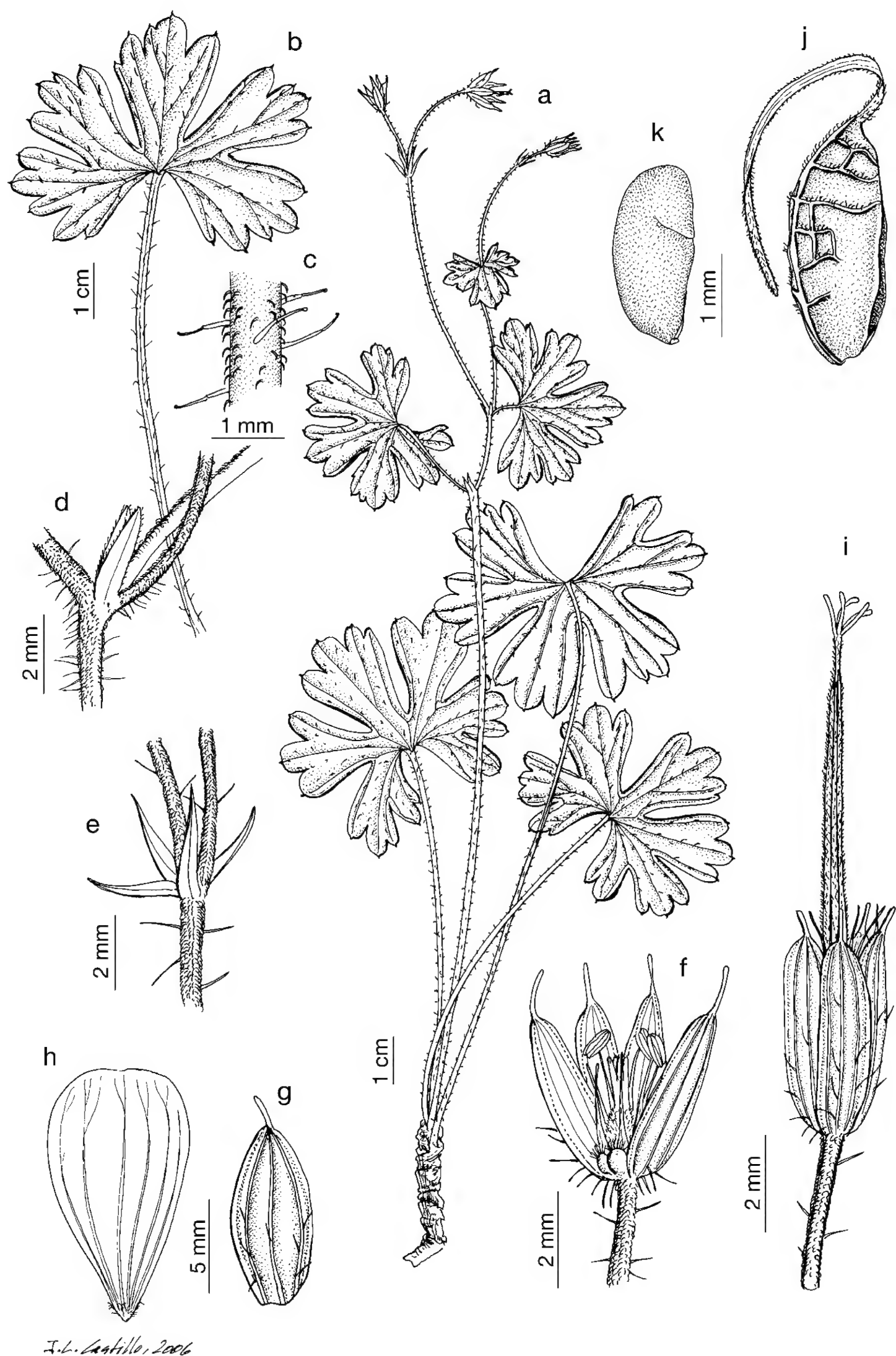


Figure 5. Distribution of *Geranium hispidissimum* (Franch.) R. Knuth (dots) and *G. wardii* Yeo (squares).

Discussion. *Geranium hispidissimum* shares with *G. strictipes* an erect habit, stout, vertical rootstock, opposite leaves, and inflorescence in dichasial cyme with monochasial branches. *Geranium hispidissimum* is, however, easy to identify from its less deeply divided leaves and its shorter petals. It also has shorter sepals, staminal filaments, anthers, fruit, rostrum narrowed apex and seeds. These features overlap to some degree. The indumentum of *G. hispidissimum* is also variable but is usually denser than in *G. strictipes*, especially on the leaves. *Geranium hispidissimum* and *G. strictipes* share with *G. moupinense* sepals with longer mucro. In these species the sepal mucro is green; in the remaining species of the section it is purple. The ranges of *G. hispidissimum* and *G. strigosum* overlap, and they occur sometimes in the same locality. Knuth (1912) recognized *G. platylobum* but did not indicate any

difference from *G. strictipes* to key it out. According to Yeo (1992), *G. platylobum* is an extreme case with unusual rounded leaf segments and obtuse lobes. The study of the type material shows that *G. platylobum* has short petals and leaves that are not as deeply divided as in *G. hispidissimum*.

Additional specimens examined. CHINA. **Sichuan:** Huei-li Hsien, 26°41'N, 102°15'E, *T. T. Yü* 1541 (CH). **Yunnan:** Yun-nan-sen, 25°28'N, 100°33'E, *Bélard* 15 (P); entre Yun-nan-sen et Nang-tzé, 25°28'N, 100°33', Aug. 1897, *Bélard s.n.* (P); Ahsi NW Likang-Snow range on Yangtze, 26°48'N, 100°16'E, *R. C. Ching* 20787 (A, PE); col du Hee-chan-men, 26°6'N, 99°57'E, *P. J. Delavay* 4827 (MA, P); Yunnan sen, 25°28'N, 100°33'E, *F. Ducloux* 432 (P); Chien Chuan to Sung Kwei pass, 25°59'N, 100°5'E, *G. Forrest* 132 (E); Yunnan, prope urbem Yungbei, inter vic. Dschaoping et Boloti, 24°16'N, 102°23'E, *H. F. Handel-Mazzetti* 3358 (W, WU); ad orientem urbis Lidjiang (Likang) supra vicum Duinaoko, 24°58'N, 101°29'E, *H. F. Handel-Mazzetti* 3461 (W, WU); near Ta-tsang-kai,



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Figure 6. *Geranium moupinense* Franch. —A. Habit. —B. Leaf. —C. Petiole indumentum. —D. Stipules. —E. Bracteoles. —F. Flower without petals. —G. Sepal. —H. Petal. —I. Fruit. —J. Mericarp. —K. Seed. Based on A. David s.n. (MA-628480).

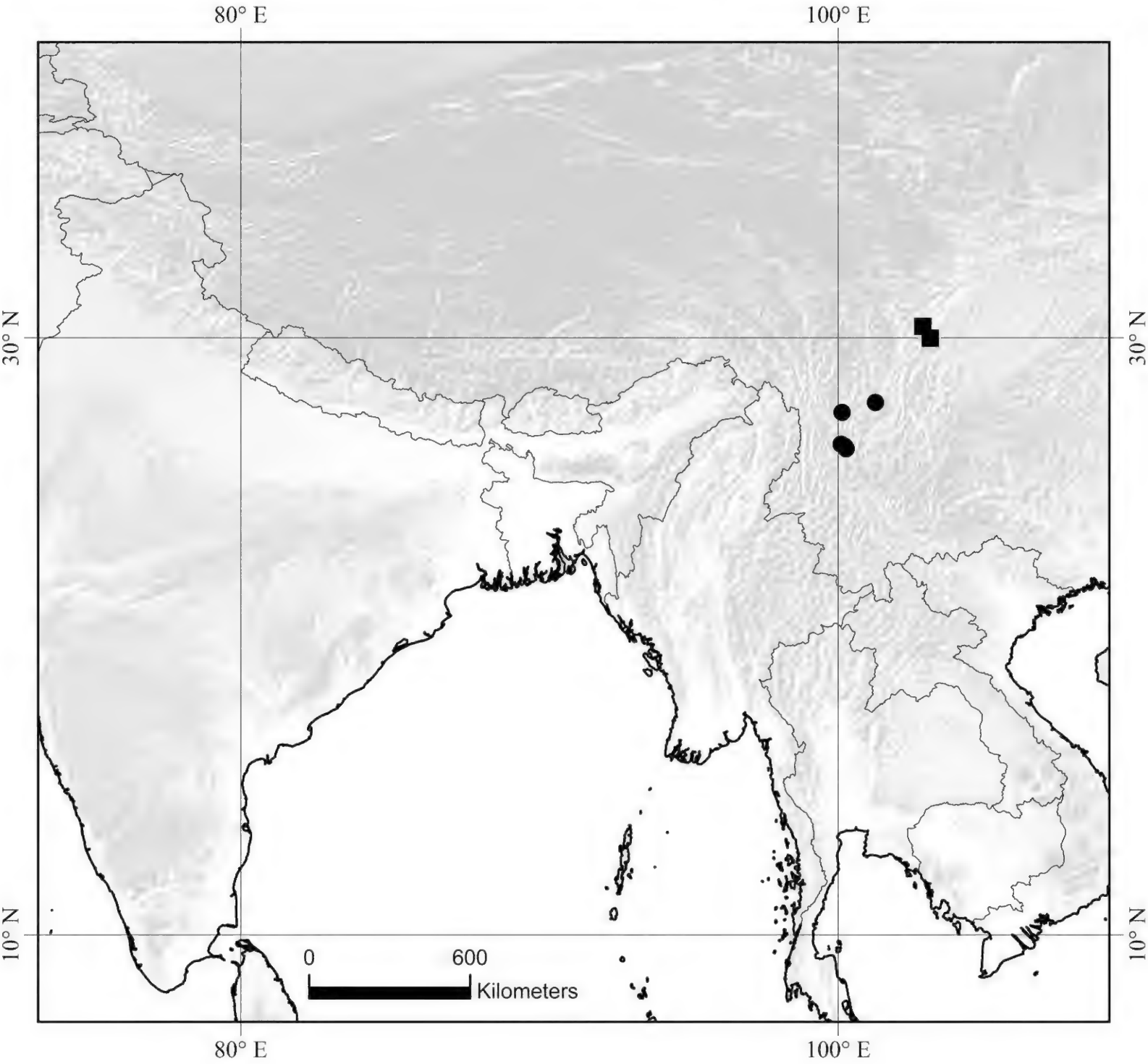


Figure 7. Distribution of *Geranium umbelliforme* Franch. (dots) and *G. moupinense* Franch. (squares).

27°30'N, 100°45'E, *F. Kingdon Ward 3971* (E); Yun-nan sen, 25°28'N, 100°33'E, *E. E. Maire 2577* (E); Yun-nan sen, 25°28'N, 100°33'E, *E. E. Maire 884* (BM); Ta Kai plateau, 1913, *E. E. Maire s.n.* (E); Lou Pou mtns., 25°28'N, 101°17'E, *E. E. Maire s.n.* (P); Dongchouan, 25°28'N, 101°17'E, July, *E. E. Maire s.n.* (BM, E, P); ad viam Yunnanfu-Suifu, 28°42'N, 104°30'E, 4 Sep. 1914, *R. Mell s.n.* (W); distr. Dali, población He Qing, montaña Ma Er Shan, 26°31'N, 100°11'E, *Qin 23372* (E, PE); Songmoing Xian, in the vic. of Longtan, 59 km N of Kunming, 25°28'N, 102°46'E, *Sino-Amer. Bot. Exped. 1349* (A, CAS, E, K); *C. W. Wang 70873* (A); Li-kiang Hsien, 26°53'N, 100°14'E, *C. W. Wang 71296* (A).

2. *Geranium moupinense* Franch., *Nouv. Arch. Mus. Hist. Nat.* ser. 2 8(2): 208. 1885. TYPE: China. Sichuan: Moupine, 30°23'N, 102°50'E, June 1869, *A. David s.n.* (lectotype, here designated, P!; isotype, MA!). Figure 6.

Geranium ascendens Z. M. Tan, *Bull. Bot. Res.*, Harbin 10(1): 23, tab. 1. 1990. TYPE: China. Sichuan: Yaan,

29°59'N, 103°05'E, 1988, *Chengdu College of Traditional Chinese Medicine Exped. 102* (holotype, SZ image!; the type was originally at CDCM).

Perennial herbs, 12–25 cm. Stem erect, leafy, with uncinat, eglandular hairs 0.1–0.3 mm and patent, glandular hairs 0.7–1.1 mm. Basal leaves in a ± persistent rosette, cauline leaves alternate; leaf laminas 3.6–5.8 × 4.6–5.5 cm, palmatifid (ratio of main sinus length:middle segment length = 0.76–0.81), polygonal in outline, base cordate, pilose, with ± appressed, eglandular hairs and plane, glandular hairs on both surfaces; segments 5, middle segment obtriangular, 3.7–6.9 mm wide at base, 3- to 7-lobed in distal half; petioles up to 12 cm, with uncinat eglandular hairs 0.1–0.2 mm and patent, glandular hairs 0.8–1.1 mm; stipules 4.9–5.1 × 1.5–1.6 mm, broadly lanceolate, free, brown, with scattered eglandular hairs on abaxial surface and margin,

glabrous adaxially. Inflorescence a monochasial cyme; cymules 2-flowered, solitary; peduncles 48–72 mm, with uncinata, retrorse, eglandular hairs 0.2–0.3 mm and patent, glandular hairs 0.8–1.6 mm; bracteoles $5\text{--}6.6 \times 1\text{--}1.2$ mm, lanceolate, whorled; pedicels 25–28 mm, with uncinata, retrorse, eglandular hairs 0.2–0.3 mm and patent, glandular hairs 0.7–1.1 mm. Flowers actinomorphic. Sepals $7.9\text{--}8.9 \times 1.8\text{--}4.3$ mm, lanceolate, smooth, not accrescent, with mucro 1.7–1.8 mm (ratio of mucro length:sepal length = 0.19–0.22), with $\pm$ patent, eglandular hairs 0.1–0.3 mm and patent, glandular hairs 1.4–1.8 mm. Petals $12\text{--}12.2 \times 5.3\text{--}7.7$ mm, erect-patent, entire, without claw, purple, hairy on base of both surfaces and margin with hairs ca. 0.2 mm. Staminal filaments 2.7–4 mm, lanceolate, white, pilose on abaxial surface, ciliate on proximal half, with hairs 0.4–1 mm; anthers 1.6–1.7 mm, unknown color. Nectaries 5, hemispheric, with tuft of hairs at top, dorsally glabrous. Gynoecium 5–5.5 mm, unknown color. Fruit 20–23 mm; mericarps $3\text{--}3.2 \times 1\text{--}1.1$ mm, reticulate, brown, with $\pm$ appressed, eglandular hairs 0.1–0.2 mm; rostrum 16.5 mm, with narrowed apex 1.5–1.7 mm, with patent, eglandular hairs 0.2–0.3 mm; stigmatic remnants 1.8–2 mm, with 5 glabrous lobes. Seeds $2\text{--}2.1 \times 0.9\text{--}1$ mm, smooth, brown. Chromosome number not known.

Additional illustrations. Xu et al. (1998: 51, tab. 14, fig. 7).

Phenology. *Geranium moupinense* has been collected in flower in June.

Distribution and habitat. *Geranium moupinense* is present in Sichuan Province, in southwestern China, in shaded areas at unknown altitudes. Figure 7.

Discussion. *Geranium moupinense* is an erect perennial herb that shares the feature of alternating leaves on the stem with *G. polyanthes* and *G. umbelliforme*. It is easily differentiated from these species by its solitary cymules (not in umbel-like aggregates) with well-developed peduncles and pedicels. *Geranium moupinense* also has noticeably longer sepals, mucro, and nectaries, with a tuft of hairs at the top (not glabrous). Additionally, the leaves of *G. moupinense* have fewer lobes per segment. The bracteoles, sepals, and anthers are longer, and the eglandular hairs on the inflorescence are shorter. These features overlap to some degree. *Geranium moupinense* shares with *G. umbelliforme* a fruit rostrum with a well-developed narrowed apex. Unfortunately, among the few available collections,

the fruits and underground parts are poorly represented. Thus, more collections may help to clarify the degree of character variation in both rootstock and fruits within this species.

Geranium moupinense is a rare species only known from three herbarium sheets, two at P and one at MA, which seems to be part of the same gathering. They bear a similar printed label with the date “1870.” According to Franchet (1885), the collection by A. David was made in June 1869. Other species from the “Plantae Davidianae” have the same inconsistency (e.g., *Meliosma cuneifolia* Franch. [P-00732482], with a printed label dated 1870). Fortunately, in some cases the original handwritten label was kept (e.g., *Deutzia longifolia* Franch. [P-00709448], which shows that 1869 was changed to 1870 on the printed label). Yeo (1992) studied the specimens at P but considered the type as “not located.” The present data strongly suggest that these specimens with only a printed label are original material, and consequently a lectotype is proposed here.

Yeo (1992) accepted *Geranium ascendens* in his treatment of Chinese geraniums, although he examined neither the type nor the other specimens. On the basis of the protologue he considered *G. ascendens* to be related to *G. moupinense* and *G. wardii* but only pointed out its differences in regard to the latter. Xu et al. (1998) and Xu and Aedo (2008) considered *G. ascendens* a synonym of *G. moupinense*. An image of the type of *G. ascendens* fits well with *G. moupinense* because of its alternate cauline leaves, leaf lamina not deeply divided, and solitary cymules. These reasons support retaining *G. ascendens* in the synonymy of *G. moupinense*, at least until new evidence appears.

3. *Geranium nakaoanum* H. Hara, Acta Phytotax. Geobot. 16: 1. 1954. TYPE: Nepal. Chaikia to Kalun, $28^{\circ}35'N$, $81^{\circ}37'E$, 2 July 1953, S. Nakao s.n. (holotype, KYO!). Figure 8.

Perennial herbs, 7–27 cm. Stem erect or ascending, leafy, glabrous. Basal leaves in a $\pm$ persistent rosette, cauline leaves opposite (rarely alternate in middle of shoot, first node); leaf laminae $(1.2)1.6\text{--}2.2(2.5) \times 1.5\text{--}3.1$ cm, palmatifid (ratio of main sinus length:middle segment length = $[0.66]0.77\text{--}0.82[0.84]$), polygonal in outline, base cordate, pilose, with $\pm$ appressed, eglandular hairs and plane, glandular hairs on adaxial surface and glabrous on abaxial surface; segments 5, middle segment obtriangular, 1.4–2.9 mm wide at base, 3- to 8-lobed in distal half; petioles up to 18 cm, usually glabrous, sometimes with scattered eglandular hairs

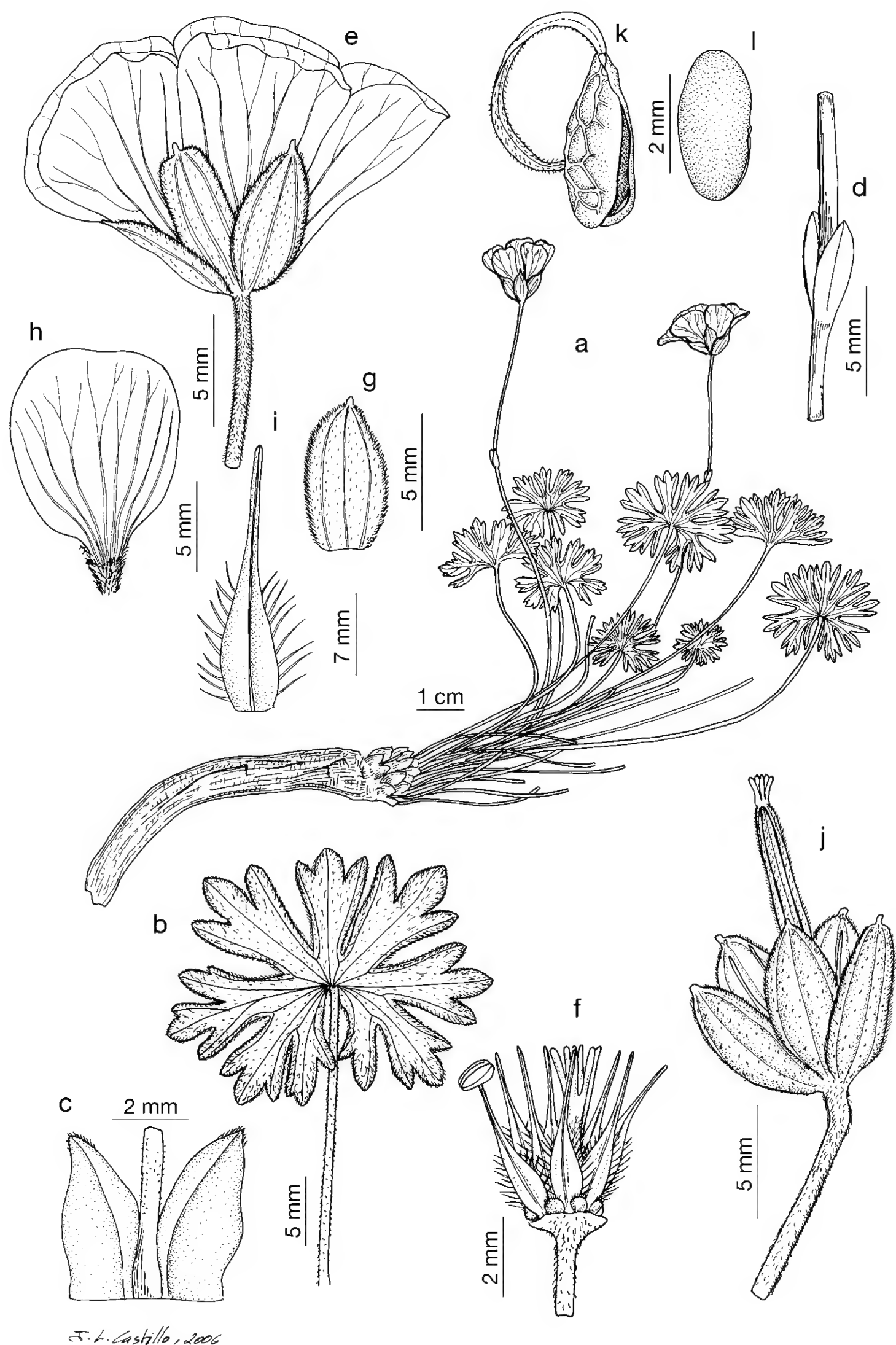


Figure 8. *Geranium nakaoanum* H. Hara. —A. Habit. —B. Leaf. —C. Stipules. —D. Bracteoles. —E. Flower. —F. Flower without petals and sepals. —G. Sepal. —H. Petal. —I. Staminal filament. —J. Fruit. —K. Mericarp. —L. Seed. A, B, D–F based on *S. Nakao s.n.* (KYO); C based on *D. McCosh 354* (BM); G–I based on *J. D. Stainton 7384* (BM); J–L based on *C. Wigram 31* (K).

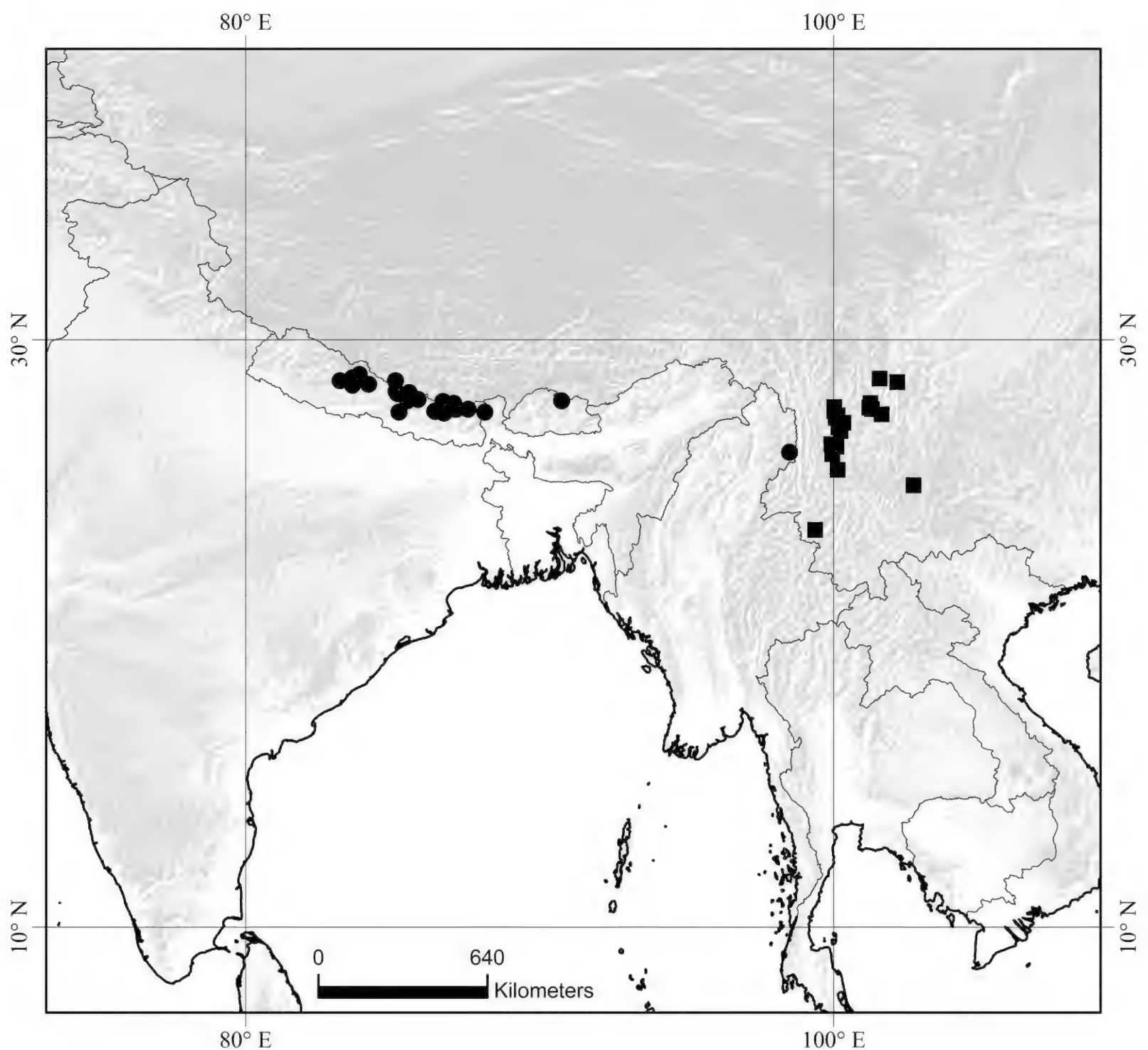


Figure 9. Distribution of *Geranium nakaoanum* H. Hara (dots) and *G. strictipes* R. Knuth (squares).

0.1–0.2 mm; stipules $2.9\text{--}4 \times 1.3\text{--}2$ mm, ovate, obtuse, free, brown, with scattered eglandular hairs on abaxial surface and margin, glabrous adaxially. Inflorescence a monochasial cyme; cymules 1(2)-flowered, solitary; peduncles 28–69(106) mm, with uncinete, retrorse, eglandular hairs 0.1–0.3 mm; bracteoles $2.7\text{--}4.9 \times 0.9\text{--}1.5$ mm, lanceolate, obtuse, subopposite; pedicels 21–44(65) mm, with uncinete, retrorse, eglandular hairs 0.2–0.3 mm. Flowers actinomorphic. Sepals (5.5)6.1–7(8.2) $\times$ 2.6–3.3 mm, lanceolate, smooth, not accrescent, with mucro 0.4–0.6 mm (ratio of mucro length:sepal length = 0.07–0.11), with uncinete, antrorse, eglandular hairs 0.1–0.4 mm. Petals (11.5)13.1–15.9(16.1) $\times$ 7–10.9 mm, erect-patent, entire, without claw, purple, hairy on base of adaxial surface, glabrous on abaxial surface, ciliate on basal margin with hairs 0.3–0.7 mm. Staminal filaments 3.5–4.6 mm, lanceolate with an abruptly narrowed apex, white, ciliate, with

eglandular hairs 0.3–1.4 mm; anthers 0.8–1 mm, yellow. Nectaries 5, hemispheric, glabrous. Gynoecium 3.7–4.3 mm, yellow. Fruit 14.5–22.9 mm; mericarps $4\text{--}4.3 \times 1.6\text{--}1.9$ mm, reticulate, brown, glabrous; rostrum 8.1–15.8 mm, without or with narrowed apex 0.5–0.8 mm, glabrous; stigmatic remnants 0.5–1.9 mm, with 5 glabrous lobes. Seeds $3\text{--}3.1 \times 1.3\text{--}1.4$ mm, smooth, brown. Chromosome number not known.

Additional illustration. Hara (1955: 277, fig. 83).

Phenology. *Geranium nakaoanum* has been collected in flower from February to August.

Distribution and habitat. *Geranium nakaoanum* is present in Himalaya, from central Nepal to Bhutan, plus in a locality in northern Burma. It is found in meadows, on open grassy or rocky slopes, and along trails, at altitudes of 3100–5000 m. Figure 9.

Discussion. *Geranium nakaoanum* is a small herb, with a vertical rootstock shortly branched at the apex and with short, erect, or ascending stems not rooting at the nodes. Basal leaves are arranged in a rosette, which is overtopped by the cymules. Cauline leaves are usually opposite, but in some individuals they are alternate in the middle of the shoot and opposite toward the apex. The cymules are borne on the short stem or, sometimes, on the rootstock. They are usually 1-flowered, although exceptionally some 2-flowered cymules occur in some predominantly 1-flowered individuals. The indumentum of the peduncles and pedicels consists of short, retrorsely appressed eglandular hairs. Both stems and petioles are glabrous, but some scattered, appressed, eglandular hairs were observed on the petioles of some individuals. Petals are long, with small hairs on the basal margin and on the base of the adaxial side. The staminal filaments have a distinctive narrowed apex and conspicuous ciliae. The variability of *G. nakaoanum* fruits should be checked with more fruiting material because only two mature fruits have been studied.

Geranium nakaoanum seems to be close to *G. polyanthes*, *G. umbelliforme*, and *G. moupinense* because of its monochasial inflorescence. It differs, however, from this group by its usually opposite leaves. *Geranium nakaoanum* shows singular characters in the section, e.g., its usually 1-flowered cymules, the scarce indumentum, and the staminal filaments with a narrowed apex.

According to Ikeda (pers. comm.), the description of *Geranium nakaoanum* was published in October 1954 (Hara, 1954) and later copied in *Flora and Fauna of Nepal* (Hara, 1955).

Additional specimens examined. BURMA. **Paijawnng Bum:** 26°10'N, 98°30'E, *F. Kingdon Ward 3438* (E). INDIA. **Bhutan:** Pangotang, Tsampa, 27°55'N, 90°45'E, *F. Ludlow & G. Sherrieff 19132* (BM, US). **Sikkim:** Bikbari campsite at the end of valley below HMI base camp, 27°32'N, 88°8'E, *B. N. Starling et al. 245* (K). NEPAL. Topke Gola, 27°38'N, 87°34'E, *L. W. Beer 8310* (BM); Maccherma, 27°54'N, 86°43'E, *J. F. Dobremez 360* (BM); Bhuanjene, 27°55'N, 85°30'E, *J. H. Haas 2118* (BM); C Nepal, Bagmati Zone, Rasuwa Distr., Gosain Kund–Bhairab Kund, 28°5'N, 85°25'E, *T. Hoshino et al. 9531084* (A); Bhairaukunda, 27°58'N, 85°52'E, *A. Maire 81* (E); Hongu Khola, 27°30'N, 86°45'E, *D. McCosh 354* (A, BM); E Nepal, Khosi Zone, Sankhuwa Sabha Distr., around Cha Ding Kharka, 27°40'N, 87°10'E, *M. Minaki et al. 90* (A, E); C Nepal, Bagmati Zone, Rasuwa Distr., around Jaisuli Kund, 28°11'N, 85°11'E, *F. Miyamoto et al. 9410140* (E); C Nepal, Bagmati Zone, Rasuwa Distr., Pabil Kharka-pass-Kharka, near Seto Kund, 28°15'N, 85°7'E, *F. Miyamoto et al. 9410228* (A, E); E Nepal, Sagarmatha Zone, Solukhumbu Distr., Gnaula-Pike, 27°33'N, 86°27'E, *F. Miyamoto et al. 9580047* (A); E Nepal, Khosi Zone, Sankhuwa Sabha Distr., Sano Birke–Jaggu Danda, 27°38'N, 87°9'E, S.

Noshiro et al. 9760340 (A); Langsisa Kharka, 28°12'N, 85°34'E, *O. Polunin 414* (BM); Dobhan, 27°32'N, 85°13'E, *K. N. Sharma E439* (BM); Mukinath, 28°49'N, 83°52'E, *J. D. Stainton et al. 1454* (A, BM, E); Taglung, S of Tukucha, Kali Gandaki, 28°42'N, 83°38'E, *J. D. Stainton et al. 1782* (BM); NW of Gurjakhani, 28°36'N, 83°13'E, *J. D. Stainton et al. 3101* (A, BM, E); Rambong, Lamjung Himal, 28°29'N, 84°11'E, *J. D. Stainton et al. 5991* (BM); Mailey Khiba, Central Nepal, 28°27'N, 83°38'E, *J. D. Stainton 7384* (BM); E Nepal, Khosi Zone, Sankhuwa Sabha Distr., around Makalu Base Camp, 27°50'N, 87°5'E, *M. Suzuki et al. 8820875* (A, E); E Nepal, Khosi Zone, Sankhuwa Sabha Distr., Cha Ding Kharka–Tutu La–Thulo Pokhari–Shipton Pass–Khongma, 27°40'N, 87°10'E, *M. Suzuki et al. 8821951* (E); E Nepal, Sagarmatha Zone, Solukhumbu Distr., Sete–Lamjura La–Taktor, 27°34'N, 86°26'E, *M. Wakabayashi et al. 9720053* (A); E Nepal, Sagarmatha Zone, Solukhumbu Distr., Chalem Kharka–Panch Pokhari–Khola Kharka, 27°35'N, 86°50'E, *M. Wakabayashi et al. 9730142* (A); E Nepal, Sagarmatha Zone, Solukhumbu Distr., Khola Kharka–Rangdu Kharka, 27°36'N, 86°50'E, *M. Wakabayashi et al. 9730163* (A); Nepal, 11 Feb. 1924, *C. Wigram s.n.* (K); Ganesh Himal, 28°10'N, 85°10'E, *B. Yon 192* (E).

4. *Geranium polyanthes* Edgew. & Hook. f. in Hook. f., *Fl. Brit. India* 1: 431. 1874. TYPE: India. Uttaranchal: Kumaon, 29°24'N, 79°30'E, *R. Blinkworth 8564* (lectotype, designated by Yeo [1992: 192], K!; isolectotypes, P!, W!). Figure 10.

Perennial herbs, 7–64 cm. Stem erect, leafy, subglabrous or with a variable indumentum composed by uncinat, eglandular hairs 0.1–0.3 mm, and sometimes patent, eglandular hairs 0.8–2.2 mm and patent, glandular hairs 0.2–1.3 mm. Basal leaves in a $\pm$ persistent rosette, cauline leaves alternate in middle of shoot and opposite at apex; leaf laminae (1.9)2.8–4.9(5.6) $\times$ 2.7–6.5 cm, palmatifid (ratio main of sinus length:middle segment length = [0.61]0.71–0.76[0.81]), polygonal in outline, base cordate, pilose, with $\pm$ appressed, eglandular hairs and plane, glandular hairs on both surfaces; segments 5, middle segment obtriangular, 3.4–8.9 mm wide at base, 3- to 10-lobed in distal half; petioles up to 32 cm, subglabrous or with variable indumentum composed by uncinat eglandular hairs 0.1–0.3 mm, and sometimes patent, eglandular hairs 0.4–1.9 mm and patent, glandular hairs 0.5–1.2 mm; stipules 4.9–8.3 $\times$ 1.5–4.8 mm, ovate, obtuse, free, brown, with scattered eglandular hairs on abaxial surface and margin, glabrous adaxially. Inflorescence a monochasial cyme; cymules 2(3)-flowered, in dense umbel-like aggregates at top of each branch; peduncles 0(73) mm, with patent, eglandular hairs 0.6–0.7 mm; bracteoles 2.3–5.6 $\times$ 0.5–1.6 mm, lanceolate, obtuse, whorled; pedicels (1.9)3.2–17(25) mm, with uncinat, re-

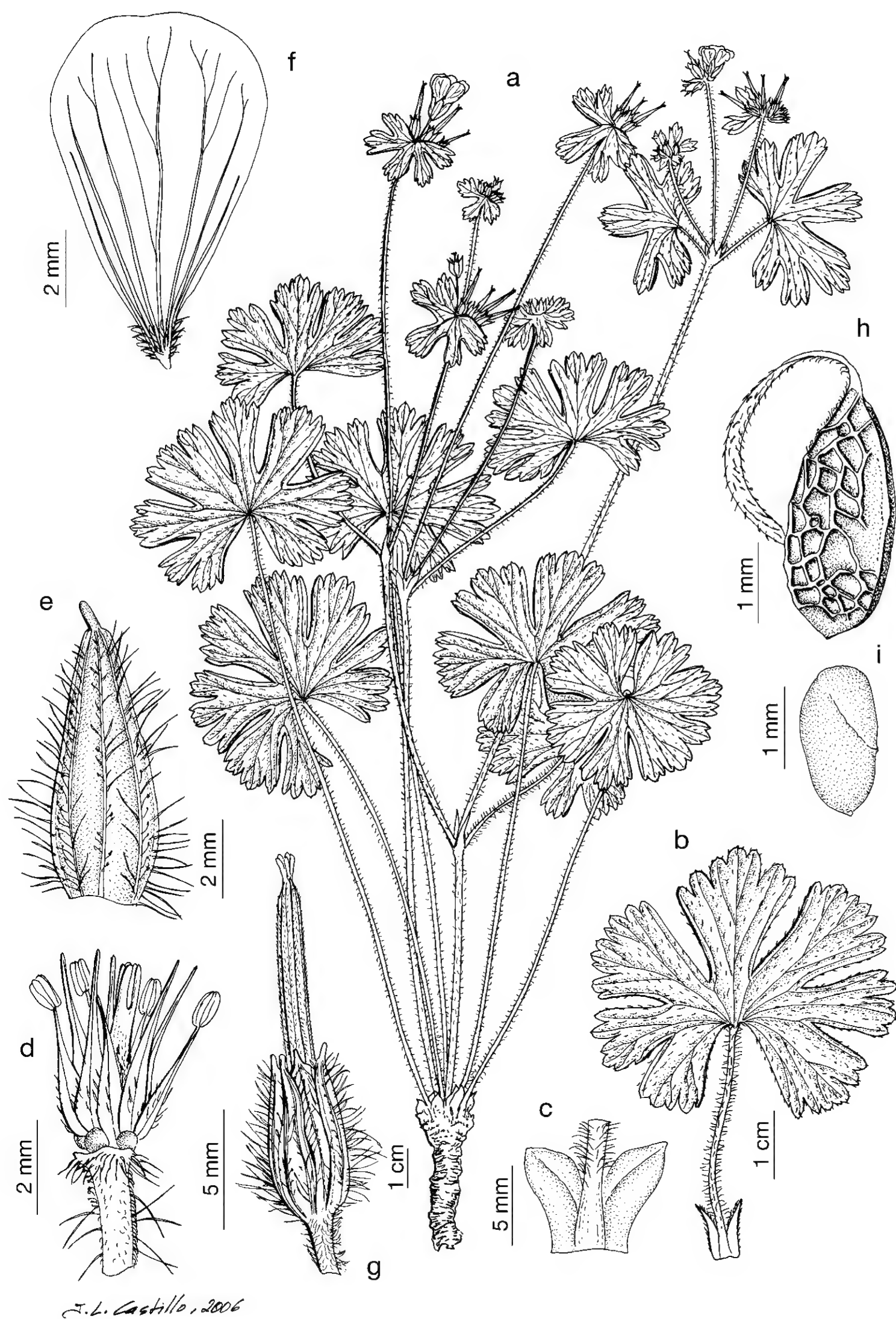


Figure 10. *Geranium polyanthes* Edgew. & Hook. f. —A. Habit. —B. Leaf. —C. Stipules. —D. Flower without petals and sepals. —E. Sepal. —F. Petal. —G. Fruit. —H. Mericarp. —I. Seed. A, C–I based on *F. Ludlow et al.* 5225 (BM); B based on *T. T. Yü s.n.* (KUN-280350).

trorse, eglandular hairs 0.2–0.3 mm, patent, eglandular hairs 1–2.3 mm, and usually, patent, glandular hairs 0.4–0.7 mm. Flowers actinomorphic. Sepals (4.9)5.7–6.9(8.2) $\times$ 1.7–3.9 mm, lanceolate, smooth, not accrescent, with mucro 0.4–0.9 mm (ratio of mucro length:sepal length = 0.06–0.16), with $\pm$ patent, eglandular hairs 0.2–2.6 mm and patent, glandular hairs 0.4–1.1 mm on abaxial surface, glabrous adaxially. Petals (7.8)9.3–11.8(14.1) $\times$ 5.1–9.1 mm, erect-patent, entire or retuse, without claw, purple, hairy on base of adaxial surface, glabrous on abaxial surface, ciliate on basal margin with hairs 0.4–0.7 mm. Staminal filaments 2.6–4.6 mm, lanceolate, white, pilose on abaxial surface, ciliate on proximal half, with hairs 0.3–0.7 mm; anthers 0.6–1.1 mm, yellow. Nectaries 5, hemispheric, glabrous. Gynoecium 3.2–4.9 mm, pink. Fruit 13–21.7 mm; mericarps 3.1–4.7 $\times$ 1.2–1.7 mm, reticulate, brown, with $\pm$ appressed, eglandular hairs 0.1–0.2 mm; rostrum 9.2–16.3 mm, without narrowed apex or with narrowed apex 0.5–1 mm, with patent, eglandular hairs 0.2–0.5 mm, and sometimes scattered, patent, glandular hairs 0.2–0.3 mm; stigmatic remnants 0.7–1.7 mm, with 5 glabrous lobes. Seeds 1.9–2.8 $\times$ 0.9–1.4 mm, smooth, brown. Chromosome number: $2n = 28$ (Warburg, 1938: 468).

Additional illustrations. Wu and Chen (1991: 94, tab. 28, figs. 6–7); Xu et al. (1998: 51, tab. 14, figs. 1–6).

Phenology. *Geranium polyanthes* has been collected in flower from April to September.

Distribution and habitat. *Geranium polyanthes* is present in Himalaya, from Uttaranchal in North India to Yunnan in southwestern China, in alpine meadows, moist fields, grassy slopes, damp banks, amongst boulders, and on the edges of *Abies* Mill., *Juniperus* L., *Picea* A. Dietr., or *Rhododendron* L. forests. The species is found at altitudes of 2000–4600 m. Figure 11.

Discussion. *Geranium polyanthes* is an erect perennial herb with a more or less vertical rootstock with thickened roots, leaves alternate in the middle of the shoot and opposite at the apex, and with a monochasial inflorescence. It is easy to identify by its distinctive dense aggregate of cymules at the apex of each branch. The cymules usually lack peduncles, have short pedicels, and are subtended by sessile or short petiolate leaves. Exceptionally, some solitary, peduncled cymules occur in individuals with cymules predominantly in umbel-like aggregates. Stipules are

ovate, obtuse, and conspicuously wide. *Geranium polyanthes* is close to *G. umbelliforme*, since both share a similar inflorescence structure and alternate cauline leaves. Nonetheless, *G. umbelliforme* has cymules in loose umbel-like aggregates usually with well-developed peduncles and narrower stipules.

According to Yeo (2002), some of the flowers of *Geranium polyanthes* are cleistogamous.

Additional specimens examined. BURMA. **Seinghku Wang:** 28°3'N, 97°35'E, *F. Kingdon Ward 7013* (K), 7221 (K). CHINA. **Xizang:** distr. Milin, 29°15'N, 93°0'E, *Exp. Medicina Herbacea China 3923* (PE); Tha Chu valley, 31°3'N, 81°19'E, *F. Kingdon Ward 19651* (BM); valley of the Di Chu, 28°20'N, 97°2'E, *F. Kingdon Ward 7194* (K); distr. Nie La Mu, pueblo Quxiang, 28°4'N, 85°59'E, *Liao Lian Rong 1911* (PE); Lo La Chu, near Molo, 28°55'N, 93°55'E, *F. Ludlow & G. Sherriff 1867* (BM); Tsari, 28°42'N, 93°18'E, *F. Ludlow & G. Sherriff 2124* (BM); Senguti, Tsari, 28°40'N, 93°20'E, *F. Ludlow & G. Sherriff 2467* (BM); Tamnyen Chu, Kongbo valley, 29°20'N, 94°43'E, *F. Ludlow & G. Sherriff 4899* (BM); Kongbo, SE Tibet, 29°30'N, 94°53'E, *F. Ludlow & G. Sherriff 14389* (BM); Kongbo, Doshong La, 29°31'N, 94°51'E, *F. Ludlow et al. 5225* (A, BM); Langong, 28°45'N, 94°0'E, *F. Ludlow & G. Sherriff 5504* (BM); distr. Motuo, pueblo Nage, 28°44'N, 94°53'E, *Qinghai-Tibet Exp. 74-3802* (PE); Thibet oriental, Sila Kynadla, 28°29'N, 98°54'E, *J. A. Soulié 1099A* (P); Thibet oriental, Sila Thrhana, 28°29'N, 98°54'E, *J. A. Soulié 1312A* (P); upper Kiubiang Valley, Chulung, Chialohmuto, 28°18'N, 89°12'E, *T. T. Yü 19713* (A, E, KUN); upper Kiubiang Valley, Chulung, Chialohmuto to Tsugum Mtn., 28°18'N, 89°12'E, *T. T. Yü s.n.* (KUN). **Yunnan:** Tsekou, 28°29'N, 98°54'E, June 1905, *A. K. Bulley s.n.* (K); distr. Deqin, rivera del río Cangjiang, montaña Yongzi, 28°29'N, 98°54'E, *K. M. Feng 6449* (PE); distr. Deqin, rivera del río Cangjiang, montaña Yongzi, 28°29'N, 98°54'E, *K. M. Feng 6521* (PE); Lancang/Jinsha Jiang divide, Awa, 27°25'N, 99°18'E, *G. Forrest 25537* (E, NY, P, W); Gongshan Xian, Cikai Zheng, Labadi, along a branch of the Pula He on the rd. from Gongshan to Kongdang, E side of Gaoligong Shan, 27°48'N, 98°29'E, *Gaoligong Shan Biodiversity Survey 16972* (CAS, GH); Gongshan, Cikai, ca. 1.2 km SSE of the Heipa Pass tunnel on the new rd. from Gongshan to the Dulong Jiang valley, 27°45'N, 98°27'E, *Gaoligong Shan Biodiversity Survey 32158* (CAS); Gongshan, Cikai, near Yipsaka lake, 2.1 km SSE of Heipa Pass tunnel on the new rd. from Gongshan to the Dulong Jiang valley, E side of Gaoligong Shan, 27°45'N, 98°27'E, *Gaoligong Shan Biodiversity Survey 32220* (CAS, GH, MA); Gongshan, Bingzhongluo, SW of Fucui, betw. Niwalo & Chukuai lake along N side of Nianwaluo He, 12.4 km WSW of Bingzhongluo, E side of Gaoligong Shan, 27°59'N, 98°30'E, *Gaoligong Shan Biodiversity Survey 32907* (CAS, GH, MA); jugi Schöndsu-la inter fluvios Lu-djiang (Salween) et Landsang-djiang (Mekong), 28°4'N, 98°44'E, *H. F. Handel-Mazzetti 8253* (WU); inter fluvios Lu-djiang (Salween) et Djiou-djianj (Irradi Orient.), 27°58'N, 98°50'E, *H. F. Handel-Mazzetti 9525* (W, WU); sources of the Irrawaddy, Adung valley, 28°20'N, 97°40'E, *F. Kingdon Ward 9783* (BM); Tsekou, 28°29'N, 98°54'E, June 1905, *T. Manberg s.n.* (K); Mt. Kenyichunpo & region of Champutong, Salween-Irrawadi watershed, 28°3'N, 98°35'E, *J. F. Rock 10188* (E, US); Si-Kang, Chi-na-tung, Tsawa-rung, 27°45'N, 98°42'E, *C. W. Wang 65221* (A);

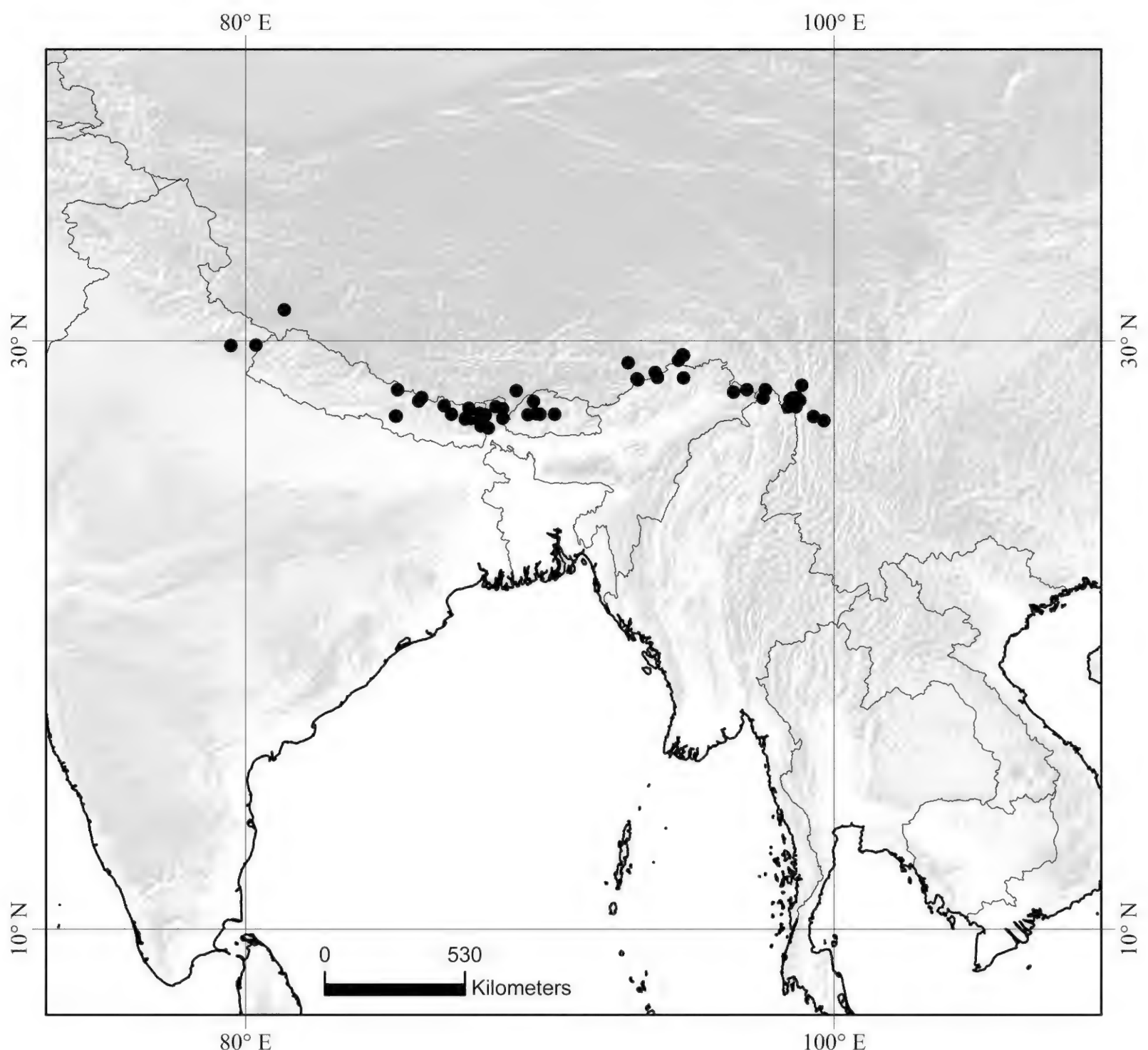


Figure 11. Distribution of *Geranium polyanthes* Edgew. & Hook. f.

Upper Kiukiang Valley (Clulung), Chialahmuto, 27°17'N, 99°39'E, *T. T. Yü* 19713 (GH); Mekong-Salween, Sewalongba, 28°4'N, 98°44'E, *T. T. Yü* 22528 (A, E). **INDIA.** **Assam:** Dolei valley, 28°15'N, 96°35'E, *F. Kingdon* Ward 8667 (K). **Bhutan:** Tsonga, 27°30'N, 90°30'E, *R. E. Cooper* 2286 (E); Phajudin [Pajoding] Juipu, 27°31'N, 89°52'E, *R. E. Cooper* 2548 (E); Nabi to Hinglai-La, 27°30'N, 90°0'E, *B. J. Gould* 844 (K); above Motithang, Thimphu, 27°29'N, 89°36'E, *A. J. Grierson & D. G. Long* 2742 (E); Upper Mo Chu Distr., betw. Gasa & Pari La, 27°56'N, 89°47'E, *I. W. Sinclair & D. G. Long* 5052 (E). **Sikkim:** Sikkim, Tongloo, *T. Anderson* 412 (M); Sikkim, 27°45'N, 88°30'E, *G. H. Cave* 30 (WRSL); Eantso La, 27°45'N, 88°30'E, *G. H. Cave* 1212 (WRSL); Yampung, 27°23'N, 88°5'E, 1 July 1922, *G. H. Cave* s.n. (E); Jolumbo, 27°45'N, 88°30'E, *C. B. Clarke* 25608 (K); Kapup, 27°22'N, 88°44'E, *R. E. Cooper* 761 (E); Sikkim, Lachung valley, 27°41'N, 88°44'E, Aug. 1892, *G. A. Gammie* s.n. (P, US, W); Damphibkei, 27°16'N, 88°2'E, *R. Lepcha & Ribu* 1088 (E); Jongri, 27°28'N, 88°9'E, 1913, *R. Lepcha & Ribu* 6590 (E); West Distr., Chhurong, Chhu valley betw. Jamlinghang & Bikbari, 27°29'N, 88°9'E, *D. G. Long et al.* 238 (E); West Distr., Dzongri, 27°28'N,

88°9'E, *D. G. Long et al.* 427 (E); apud vicum Yumthang, 27°41'N, 88°44'E, 16 Aug. 2003, *M. Nohelová* s.n. (B). **Uttaranchal:** Kumaon, Jimba, on way from Bonato to Darma Vy, 29°51'N, 80°21'E, *W. Koelz* 20970 (NY). **West Bengal:** Darjiiling, 27°2'N, 88°15'E, *C. B. Clarke* 27598 (K); Singalila Ridge, Sandakphu, 27°6'N, 88°0'E, *G. Rai* 312 (B). **NEPAL.** Iswa Khola, 27°30'N, 87°0'E, *L. W. Beer* 25495 (BM); Milke Dobaye, 27°23'N, 87°29'E, *J. F. Dobremez* 1582 (BM, E); Topke Gola, 27°42'N, 87°35'E, *J. F. Dobremez* 1722 (E); Taplejung, Ghunsa, Yonpma Khola valley above Phole, 27°21'N, 87°40'E, *Gray* 31 (K); Mechi Zone, Taplejung Distr., Lamo Pokhari–Dobate–Hike Khar-ka, 27°20'N, 87°28'E, *Y. Omori et al.* 9920037 (E); Mahalangur Himal, Khumbu, Paugpoche, 27°47'N, 86°45'E, *J. Poelt* 6329 (M); Chuwar, 27°26'N, 85°6'E, 14 *K. N. Sharma* 421 (E); Jshade, Ghopte, 27°26'N, 85°7'E, *T. B. Shrestha & P. R. Shakya* 3758 (US); Central Region, Bagmati Zone, Sindhupalchok Distr., Phunboche Danda, S Bhairab Kund, 27°57'N, 85°53'E, *M. F. Watson et al.* EKSIN 219 (E); Yimbua Yuola, 27°32'N, 87°57'E, *L. H. Williams* 824 (BM); Ganesh Himal, 28°20'N, 85°10'E, *B. Yon* 426 (E).

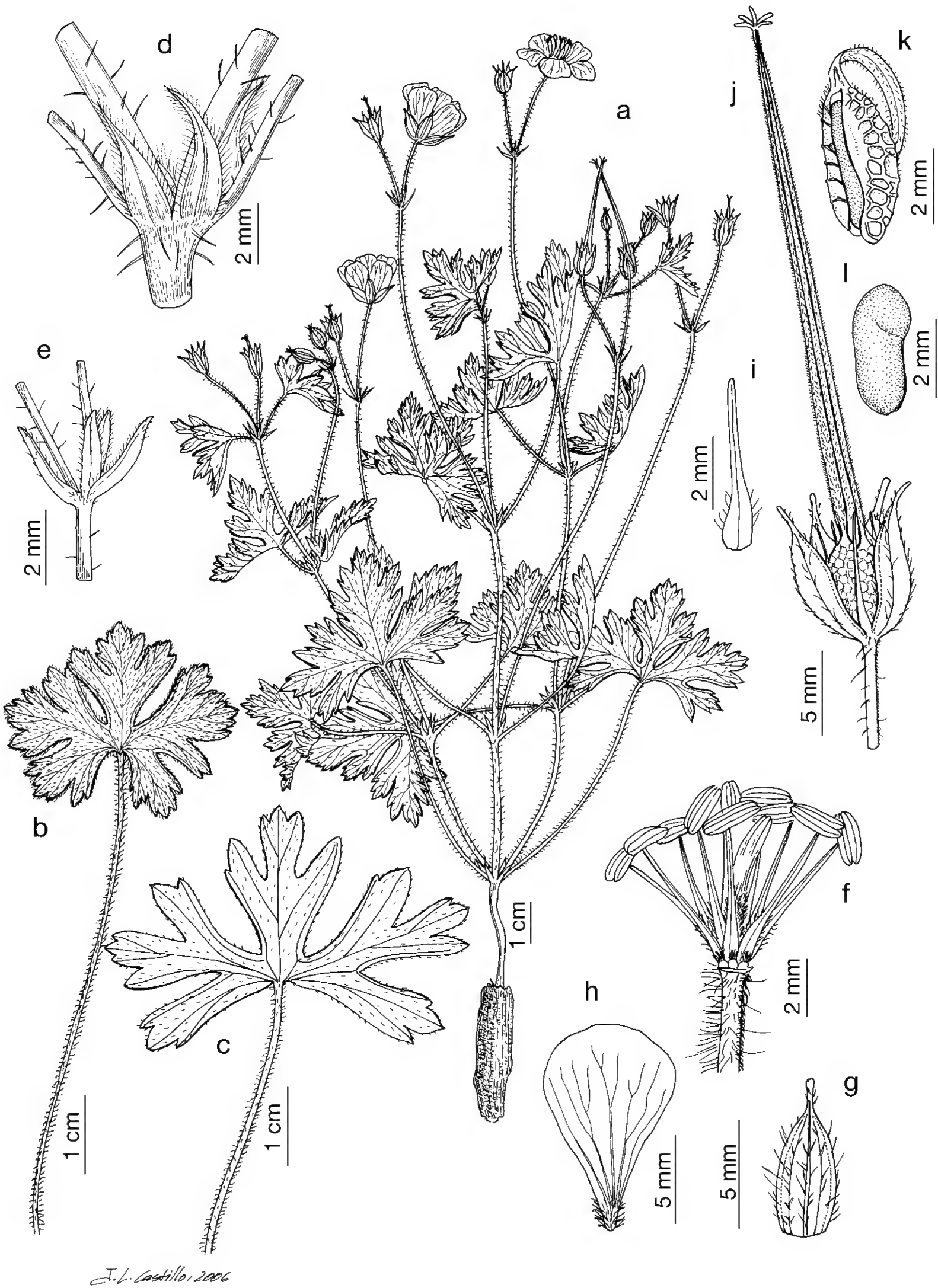


Figure 12. *Geranium strictipes* R. Knuth. —A. Habit. —B, C. Leaves. —D. Stipules. —E. Bracteoles. —F. Flower without petals and sepals. —G. Sepal. —H. Petal. —I. Staminal filament. —J. Fruit. —K. Mericarp. —L. Seed. A, C–I based on *G. Forrest* 2369 (BM); B based on *Zhong Dian Expedition* 606 (PE); J–L based on *G. Forrest* 6113 (E).

5. *Geranium strictipes* R. Knuth in Engl., Pflanzenr. IV. 129 (Heft 53): 581. 1912. TYPE: China. Yunnan: eastern flank of the Lichiang range, 27°20'N, 100°08'E, June 1906, *G. Forrest* 2369 (holotype, E!; isotypes, BM!, K!, P!). Figure 12.

Geranium strigosum Franch., Bull. Soc. Bot. France 33: 442. 1887, nom. illeg., non Burm. f., 1768. *Geranium strigosum* var. *gracile* Franch., Pl. Delavay. 113. 1889 (Yeo [1992: 197] designated the type of *Geranium strigosum* var. *gracile*; for more details see discussion). TYPE: China. Yunnan: montis Pe-ngay-tze, supra Houang-kia-pin, 25°34'N, 100°08'E, 4 Sep. 1882, *P. J. Delavay* *Geranium*, n. 2 (lectotype, designated here, P!).

Geranium strigosum var. *grandiflorum* Franch., Pl. Delavay. 113. 1889. *Geranium strictipes* var. *grandiflorum* (Franch.) C. Y. Wu ex H. W. Li, Vasc. Pl. Hengduan Mount. 1: 1026. 1993. TYPE: China. Yunnan: collum Koua-la-po, Hee-chan-men, 26°06'N, 99°57'E, 14 June 1887, *P. J. Delavay* s.n. (lectotype, designated here, P!; isoelectotypes, K!, NY!).

Perennial herbs, 20–76 cm. Stem erect or ascending, leafy, with patent, eglandular hairs 0.2–2.2 mm, and usually patent, glandular hairs 0.4–3.4 mm, sometimes subglabrous. Basal leaves in deciduous rosette, cauline leaves opposite; leaf laminae (1.8)2.5–3.6(4.9) × 2.8–5.9 cm, palmatifid (ratio of main sinus length:middle segment length = [0.70]0.80–0.86[0.89]), polygonal in outline, base cordate, pilose, with ± appressed, eglandular hairs and plane, glandular hairs on both surfaces; segments 5, middle segment rhombic, 3.2–10.6 mm wide at base, 8- to 16-lobed in distal half; petioles up to 15 cm, with uncinat, eglandular hairs 0.1–0.3 mm, patent, eglandular hairs 0.4–2 mm and usually patent, glandular hairs 0.2–2.7 mm; stipules 3.8–10 × 0.5–2.3 mm, lanceolate, free, green, with scattered eglandular hairs on abaxial surface and margin, glabrous adaxially. Inflorescence a dichasial cyme with monochasial branches; cymules 2-flowered, solitary; peduncles (40)51–82(109) mm, with uncinat, eglandular hairs 0.1–0.3 mm, patent, eglandular hairs 0.3–2.3 mm, and patent, glandular hairs 0.4–1.7 mm; bracteoles 3.1–8.9 × 0.4–1.2 mm, lanceolate, whorled; pedicels (4.6)9.7–21.9(25) mm, with uncinat, retrorse, eglandular hairs 0.2–0.3 mm, patent, eglandular hairs 0.2–1.9 mm, and patent, glandular hairs 0.4–1.7 mm. Flowers actinomorphic. Sepals (5.5)6.1–7.3(7.8) × 2.2–3.3 mm, lanceolate, smooth, not accrescent, with mucro 0.8–2.3 mm (ratio of mucro length:sepal length = 0.12–0.35), with patent, eglandular hairs 0.2–1.9 mm and patent, glandular hairs 0.8–2.8 mm on abaxial surface, glabrous adaxially. Petals (10.2)12–13.2(14.9) × 4.1–10.1 mm, erect-patent, entire or slightly notched (notch 0.5–1 mm deep), without

claw, purple, hairy on base of both surfaces and basal margin, with hairs 0.3–1 mm. Staminal filaments 3.7–6.2 mm, lanceolate, yellow, pilose on abaxial surface, ciliate on proximal half, with hairs 0.2–0.8 mm; anthers 1–2.7 mm, yellow. Nectaries 5, hemispheric, with a tuft of hairs at top, dorsally glabrous. Gynoecium 4.8–6.6 mm, yellow. Fruit 26–46.2 mm; mericarps 5–5.6 × 1.1–2.4 mm, reticulate, brown, with ± appressed, eglandular hairs 0.1–0.2 mm; rostrum 19–37 mm, with narrowed apex 1–2.6 mm, with patent, eglandular hairs 0.1–0.4 mm, and sometimes scattered, patent, glandular hairs 0.1–0.4 mm; stigmatic remnants 1.9–2.7 mm, with 5 glabrous lobes. Seeds 3.3–4.4 × 1.3–1.9 mm, smooth, brown. Chromosome number not known.

Additional illustrations. Tan (1991: 35, tab. 9, figs 1–6; 37, tab. 10, figs. 4–6, sub *Geranium strigosum*); Wu and Chen (1991: 86, tab. 25, figs. 3–4); Xu et al. (1998: 49, tab. 13, figs. 7–10).

Phenology. *Geranium strictipes* has been collected in flower from April to November.

Distribution and habitat. *Geranium strictipes* is present in Sichuan and Yunnan Provinces in southwestern China, in meadows, amongst scrub, and on stony banks at the edges of *Quercus* L. or *Pinus* L. forests. The species is found at altitudes of 1620–3660 m. Figure 9.

Discussion. *Geranium strictipes* is an erect herb with a very stout, more or less vertical rootstock, opposite leaves, and inflorescence a dichasial cyme with monochasial branches. According to Yeo (1992), *G. strictipes* is apparently the closest relative of *G. hispidissimum*. Their leaves, however, differ significantly. Leaves of *G. strictipes* are more deeply divided because the main and second sinuses are deeper. In addition, the main segment is narrower at the base in *G. strictipes*. The middle segment of the leaf lamina is rhombic in *G. strictipes*; in *G. hispidissimum* the middle segment is obtriangular. *Geranium strictipes* has longer petals, with more dense indumentum on the abaxial base, than in *G. hispidissimum*.

The indumentum of *Geranium strictipes* varies, with some individuals subglabrous on stem and petioles, to others covered by a quite dense indumentum. The glandular hairs are sometimes absent on the stem and the petioles and vary greatly in density on the inflorescence. According to Yeo (1992), the glandular hairs of *G. strictipes* have distinctly small swollen heads, while in *G. hispidissimum* they have minute terminal cells, occasionally swollen but usually not.

This feature seems to be constant in *G. strictipes* but varies in *G. hispidissimum*. In the latter, both glandular hairs with a minute or distinct head appear, which limits its taxonomic use.

Franchet (1887: 442) described *Geranium strigosum* as a species without infraspecific taxa from “Yun-nan, in dumetis Pe-ngay-tze, supra Houang-kia-pin; fl. fr. 4 sept. (Delav. n.).” Two years later Franchet (1889) recognized under his *G. strigosum* four varieties: α *hispidissimum*, β *grandiflorum*, γ *gracile*, and δ *platylobum*. Two of these are currently separated as *G. hispidissimum* (varieties α and δ) (Yeo, 1992). Neither of the remaining two have the epithet “*strigosum*,” which corresponds to the typical variety. However, γ *gracile* is described from two collections, the first being the same as *G. strigosum*: “In dumetis Pe-ngay-tze, supra Houang-kia-pin; fl. fr. 4 sept. 1882 (Delavay, *Geranium*, n. 2; in monte Che-tcho-tze (id).” This strongly suggests that Franchet considered such variety as the typical, as Knuth (1912) indicated. Therefore, I have lectotypified *G. strigosum* on *Delavay Geranium* n. 2. The result is that *G. strigosum* var. *gracile*, typified by Yeo (1992) on the same specimen, becomes homotypic of *G. strigosum*. Yeo (1992) was aware of this coincidence of localities but considered the type of *G. strigosum* as non vidi.

Wu (1984) proposed the combination *Geranium strictipes* var. *grandiflorum*, which is not validly published according to Articles 41.5 and 41.6 of the ICN (McNeill et al., 2012), because he cited the basionym and its author but without reference to its place of valid publication.

Additional specimens examined. CHINA. **Sichuan:** Jiulong Xian, betw. city Jiulong & Yalong Jiang, right side hwy. going toward Yalong Jiang, 28°40'N, 101°34'E, Boufford et al. 33029 (A, MA); Muli Xian, border of Muli Xian & Yanyuan Xian on E side rd. (hwy. 216), 27°41'N, 101°13'E, D. E. Boufford et al. 42801 (MA); ad oppidum Yenyüen regione, in steppis ad vic Schuitangdse, 27°27'N, 101°38'E, H. F. Handel-Mazzetti 2830 (WU); ad oppidum Yenyüen regione, inter vicos Dnörlliandgse et Hungga, 27°27'N, 101°38'E, H. F. Handel-Mazzetti 2888 (WU); inter oppidum Yenyüen et flumen Yalung, 27°38'N, 101°18'E, H. F. Handel-Mazzetti 5410 (W, WU); Muli, 27°50'N, 101°15'E, F. Kingdon Ward 4040 (E), 4279 (E); Kientchang, Mienming, 28°33'N, 102°10'E, A. F. Legendre 1425 (P); Szechuan asutral inter Yenyuan hsien et Yung ming, pr. pagum Hunka, 27°38'N, 101°18'E, C. Schneider 1171 (G, GH). **Yunnan:** Diqing pref., betw. Zhongdian & Jiulong, 27°42'N, 100°1'E, B. Aldén et al. 1268 (E); Zhongdian, rd. to Haba Shan, 27°33'N, 100°1'E, *Alpine Garden Soc. Exp.* 247 (E); col de Koua-la-po, 26°6'N, 99°57'E, P. J. Delavay 2165 (K, P); col de Yen-tze-hay, 26°21'N, 100°6'E, P. J. Delavay s.n. (K, P); W flank of Haba Snow range, 27°20'N, 100°4'E, K. M. Feng 1367 (A); Lichiang range, 27°25'N, 100°5'E, G. Forrest 10340 (BM); Lichiang range, 27°25'N, 100°8'E, G. Forrest 10370 (BM,

E, GH); hills forming the E boundary of the Lichiang valley, 27°25'N, 100°8'E, G. Forrest 6113 (BM, E, P); pr. urbem Lidjiang (Likiang) in monte Yülung-schan, 27°10'N, 100°20'E, H. F. Handel-Mazzetti 3798 (W, WU); Jade Dragon mtn., 27°5'N, 100°10'E, S. Y. Hu & Y. C. Kong Y080 (A); Lijiang Co., Yuhu, Xuesong Cun, Beisha Xiang, foot of Mt. Yulongxue, 27°7'N, 100°10'E, F. Konta & H. Koyama 2469 (A); Kunmin, near Hua-ji-gou, 25°2'N, 102°43'E, J. Murata & F. Yamazaki 9251 (MO); on Ma Huang Paddock, bank of Nguluke, Lichiang Snow range, 27°0'N, 100°10'E, J. F. Rock 4352 (E, US); Yangtze watershed, Likiang, E slopes of Likiang Snow Range, 27°20'N, 100°8'E, J. F. Rock 4443 (E, GH, NY, P, US); Lichiang ad pagum Ugu leh keh, 27°0'N, 100°10'E, C. Schneider 1864 (G, GH); prope Linkiang, 27°0'N, 100°10'E, C. Schneider 1869 (G, GH, K); Lijiang Co., Yulong Shan, above Gao Shan Zhi Yu Yan, 27°10'N, 100°20'E, *Sino-Brit. Lijian Exped.* 1256 (K); Lijiang Co., Yulong Shan, above Gao Shan Zhi Yu Yan, 27°10'N, 100°20'E, *Sino-Brit. Lijian Exped.* 1266 (E); Yunnan Findspot, Lijiang, Yulong Shan, Ganghoba [cultivado en Wakehurst], 27°10'N, 100°20'E, *Sino-Brit. Lijian Exped.* 603 (MA); Li-kiang Hsien, 27°0'N, 100°10'E, C. W. Wang 70555 (A); Li-kiang Hsien, 27°0'N, 100°10'E, C. W. Wang 70934 (A); Keng-Ma, 23°31'N, 99°22'E, C. W. Wang 72927b (GH); Li-kiang Hsien, 27°0'N, 100°10'E, C. W. Wang 79873 (KUN); ciudad Lijaing, 26°53'N, 100°14'E, Q. Wang 71658 (IBSC); distr. Dali, población Jian Chuan, en el camino del pueblo Dian Nan al pueblo Ma Deng, 26°26'N, 99°55'E, *Xiangko Exp.* 243 (KUN); ciudad Lijiang, pueblo Xuesong, 27°10'N, 100°20'E, T. T. Yü 15323 (PE); ciudad Lijiang, montaña Yulong, 27°10'N, 100°20'E, A. Zhang 100312 (KUN); cerca del Jardin Botanico de Lijiang, *Zhong Dian Exp.* 606 (PE).

6. *Geranium umbelliforme* Franch., Bull. Soc. Bot.

France 33: 443. 1887. TYPE: China. Yunnan: in silvis ad juga Koua-la-po, supra Hokin, 26°31'N, 100°11'E, 4 Aug. 1885, P. J. Delavay 1944 (lectotype, designated by Yeo [1992: 194], P!). Figure 13.

Perennial herbs, 28–45 cm. Stem erect, leafy, with patent, eglandular hairs 0.3–3.9 mm and patent, glandular hairs 0.7–1.8 mm. Basal leaves in a $\pm$ persistent rosette, cauline leaves alternate in middle of shoot and opposite at apex; leaf laminae (3.7)4.1–6.9(8.4) $\times$ 4.9–9.9 cm, palmatifid (ratio of main sinus length:middle segment length = [0.66]0.67–0.73), polygonal in outline, base cordate, pilose, with $\pm$ appressed, eglandular hairs and plane, glandular hairs on both surfaces; segments 5, middle segment obtriangular, 8–14 mm wide at base, 7- to 15-lobed in distal half; petioles up to 20 cm, with patent, eglandular hairs 0.4–3.9 mm and patent, glandular hairs 0.6–1.8 mm; stipules 4.5–8.7 $\times$ 1.2–2.6 mm, ovate, obtuse, free, brown, with scattered eglandular and glandular hairs on abaxial surface and margin, glabrous adaxially. Inflorescence a monochasial cyme; cymules (2)3- to 4-flowered, in loose umbel-like aggregates at top of each branch; peduncles 25–

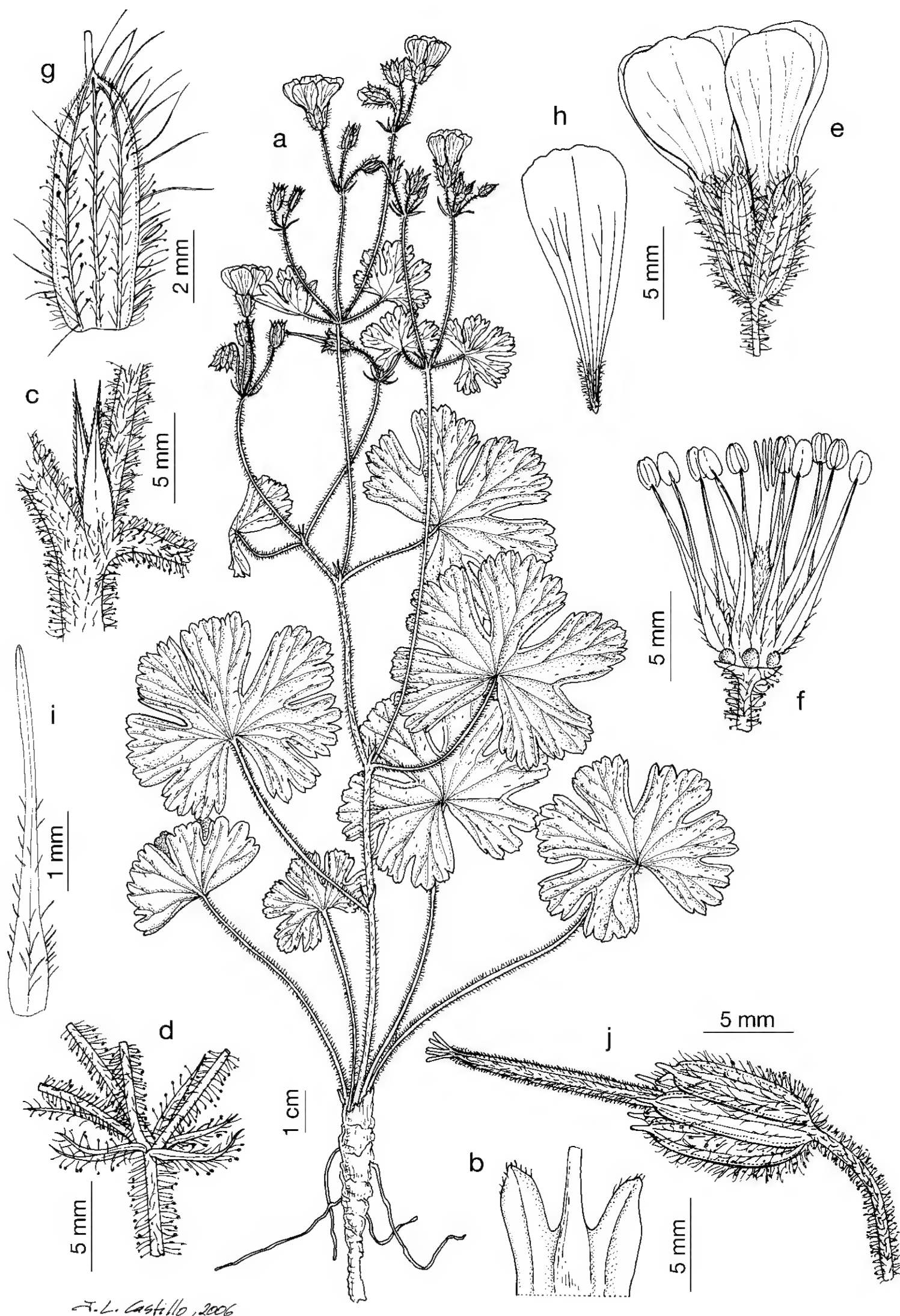


Figure 13. *Geranium umbelliforme* Franch. —A. Habit. —B, C. Stipules. —D. Bracteoles. —E. Flower. —F. Flower without petals and sepals. —G. Sepal. —H. Petal. —I. Staminal filament. —J. Fruit. E based on *G. Forrest 6195* (E).

67 mm, with patent, eglandular hairs 0.5–3 mm and patent, glandular hairs 0.6–1.8 mm; bracteoles 3.4–6 × 0.3–0.7 mm, linear-lanceolate, whorled; pedicels (5)12–34(35) mm, with patent, eglandular hairs 0.4–3.5 mm and patent, glandular hairs 0.6–1.8 mm. Flowers actinomorphic. Sepals 6.1–6.7(7.6) × 1.7–2.7 mm, lanceolate, smooth, not accrescent, with mucro 0.5–1.4 mm (ratio of mucro length:sepal length = 0.09–0.18), with patent, eglandular hairs 0.3–3.3 mm and patent, glandular hairs 0.6–1.9 mm on abaxial surface, glabrous adaxially. Petals (13.1)13.8–15.2(16.8) × 5–9 mm, erect-patent, entire or retuse, without claw, purple, hairy on base of both surfaces (mainly on adaxial one) and basal margin with hairs 0.4–1 mm. Staminal filaments 3.9–6.7 mm, lanceolate, white, pilose on abaxial surface, ciliate on proximal half, with hairs 0.3–0.9 mm; anthers 0.9–1.6 mm, unknown color. Nectaries 5, hemispheric, glabrous. Gynoecium 4.3–6.2 mm, red. Fruit 18.2–21.5 mm; mericarps 2.8–3.4 × 0.8–1.4 mm, reticulate, brown, with ± appressed, eglandular hairs 0.1–0.2 mm; rostrum 12.3–15.9 mm, with a narrowed apex 2–2.1 mm, with patent, eglandular hairs 0.3–0.4 mm, and sometimes scattered, patent, glandular hairs 0.2–0.3 mm; stigmatic remnants 1.1–1.5 mm, with 5 glabrous lobes. Seeds unknown. Chromosome number not known.

Additional illustrations. Franchet (1889, tab. 25); Wu and Chen (1991: 94, tab. 28, figs. 1–5).

Phenology. *Geranium umbelliforme* has been collected in flower from July to August.

Distribution and habitat. *Geranium umbelliforme* is present in Sichuan and Yunnan Provinces in southwestern China, in meadows and forest edges among limestone cliffs. The species is found at altitudes of 3000–3380 m. Figure 7.

Discussion. In its general aspect *Geranium umbelliforme* is similar to *G. polyanthes*. They share a similar inflorescence structure and alternate cauline leaves. Nonetheless, *G. umbelliforme* has cymules with usually well-developed peduncles and longer pedicels, resulting in a lax inflorescence. Petals of *G. umbelliforme* are longer and narrower than those of *G. polyanthes* and the narrowed apex of the fruit rostrum is longer. Additionally, the leaves of *G. umbelliforme* are longer and with more lobes per segment, bracteoles are narrower, sepal mucro is longer, and staminal filaments and anthers are longer. These features overlap to some degree.

Among the few available collections, the underground parts are poorly represented. Nevertheless,

Geranium umbelliforme appears to have a more or less vertical rootstock. Only two specimens had fruits and the seeds are unknown because these fruits were immature. Thus, more collections may help to clarify the degree of character variation in both rootstock and fruits within this species.

The ranges of these species do not overlap but are close; *Geranium polyanthes* occurs in the Himalaya in a zone about 2000 km from Uttaranchal in North India to Yunnan Province in China, whereas *G. umbelliforme* appears easternmost, in Yunnan and Sichuan Provinces.

Additional specimens examined. CHINA. **Sichuan:** Muli, 27°50'N, 101°15'E, *J. Kingdon Ward 4543* (E); Muli, mtns. of Kulu, 27°50'N, 101°15'E, *J. F. Rock 18042* (E, GH). **Yunnan:** au col de Koua-la-po, point culminant de la rte. de Ta-li à Hokin, 26°26'N, 100°6'E, 24 July 1883, *P. J. Delavay s.n.* (P); Yunnan, E flank of the Lichiang Range, 27°30'N, 100°8'E, *G. Forrest 6195* (BM, E, K, P); prefectura Dali, Henqing, pueblo Songgui, mtn. Maer Shan Yanzidong, 26°22'N, 100°13'E, *Jinshajiang Exp. 4759* (KUN); prefectura Dali, Henqing, pueblo Machang Baishanmu, 26°17'N, 100°16'E, *R. C. Ching 23481* (PE).

7. *Geranium wardii* Yeo, Notes Roy. Bot. Gard. Edinburgh 34(2): 195. 1975. TYPE: Burma. West Central Burma: Mt. Victoria, 21°14'N, 93°55'E, 26 Oct. 1956, *F. Kingdon-Ward 22760* (holotype, BM!; isotypes, CGG not seen, GB image!). Figure 14.

Perennial herbs, 23–30 cm. Stem erect or ascending, leafy, with patent, scattered, eglandular hairs 0.2–0.9 mm. Basal leaves in a deciduous rosette, cauline leaves opposite; leaf laminas 2.2–3.3 × 2.7–4.7 cm, palmatifid (ratio of main sinus length:middle segment length = 0.57–0.60), polygonal in outline, base cordate, pilose, with ± appressed, eglandular hairs and plane, glandular hairs on both surfaces; segments 5, middle segment obtriangular, 5.4–7.7 mm wide at base, 7- to 8-lobed in distal half; petioles up to 6 cm, with patent, eglandular hairs 0.3–0.4 mm and patent, glandular hairs 0.7–1 mm; stipules 2.8–5.5 × 1.7–2.4 mm, ovate, obtuse, free, brown, with eglandular and glandular hairs on margin. Inflorescence a dichasial cyme with monochasial branches; cymules 2-flowered, solitary; peduncles 29–64 mm, with uncinat, retrorse, eglandular hairs 0.2–0.3 mm and patent, glandular hairs 0.4–0.8 mm; bracteoles 4–4.5 × 0.9–1.2 mm, broadly lanceolate, obtuse, whorled; pedicels 18–38 mm, with uncinat, retrorse, eglandular hairs 0.2–0.3 mm and patent, glandular hairs 0.7–0.8 mm. Flowers actinomorphic. Sepals 6.6–11 × 3.4–4 mm, lanceolate, smooth, not accrescent, with mucro 1.1–1.2 mm (ratio of mucro length:sepal length =

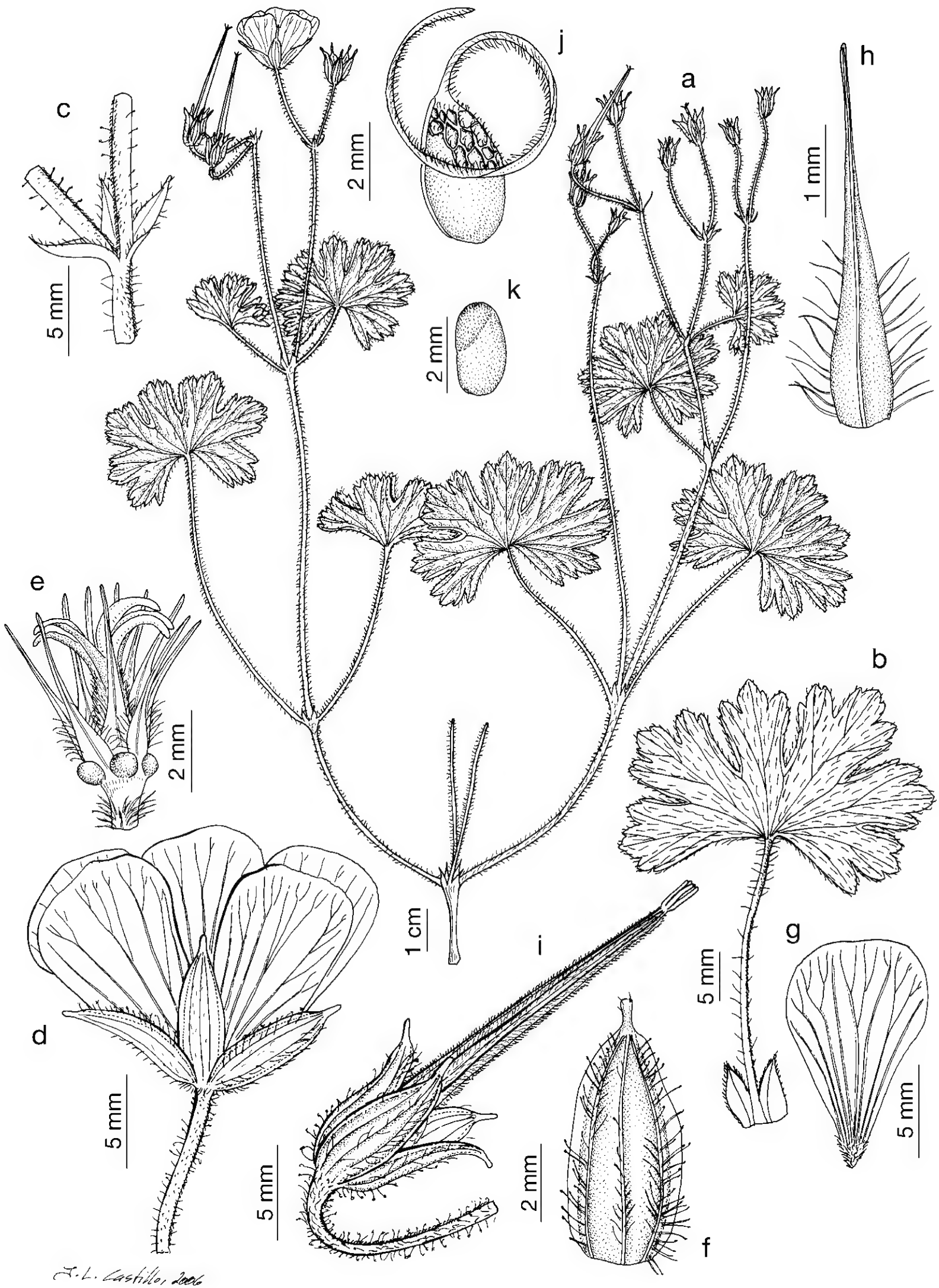


Figure 14. *Geranium wardii* Yeo. —A. Habit. —B. Leaf. —C. Bracteoles. —D. Flower. —E. Flower without petals and sepals. —F. Sepal. —G. Petal. —H. Staminal filament. —I. Fruit. —J. Mericarp. —K. Seed. Based on *F. Kingdon-Ward* 22760 (BM).

0.10–0.18), with $\pm$ patent, eglandular hairs 0.2–0.3 mm and patent, glandular hairs 1–1.3 mm on abaxial surface, glabrous adaxially. Petals 12.6–13.4 $\times$ 7.8–8.3 mm, erect-patent, entire, without claw, purple, hairy on base of adaxial surface, glabrous on abaxial surface, ciliate on basal margin, with hairs 0.3–0.5 mm. Staminal filaments 3.3–4 mm, lanceolate, purple, pilose on abaxial surface, ciliate on proximal half, with hairs 0.3–0.5 mm; anthers 1.4–1.5 mm, purple. Nectaries 5, hemispheric, glabrous. Gynoecium 4.4–5 mm, unknown color. Fruit 23–26 mm; mericarps 3.4–5.2 $\times$ 1.2–1.9 mm, reticulate, brown, with $\pm$ appressed, eglandular hairs 0.2–0.3 mm; rostrum 16–16.5 mm, without narrowed apex, with patent, eglandular hairs 0.2–0.3 mm; stigmatic remnants 1.9–2.5 mm, with 5 glabrous lobes. Seeds 2.7–2.8 $\times$ 1.5–1.6 mm, smooth, brown. Chromosome number not known.

Phenology. *Geranium wardii* was collected in flower in October.

Distribution and habitat. *Geranium wardii* is present in central-western Burma, on turf slopes at altitudes of 2500–2800 m. Figure 5.

Discussion. *Geranium wardii* is only known from the type, a flowering and fruiting collection. However, the specimens lack the rootstock and roots. *Geranium wardii* shares with *G. strictipes* and *G. hispidissimum* opposite leaves and inflorescence in dichasial cyme, with monochasial branches. The leaves of *G. hispidissimum* are similar to those of *G. wardii* in the degree of division but have more lobes per segment and a denser indumentum. The petals of *G. wardii* and *G. strictipes* are longer than those of *G. hispidissimum*. In contrast, the sepal mucro of *G. wardii* is shorter than that of *G. strictipes* or *G. hispidissimum*, and the nectaries are glabrous (with a tuft of hairs in *G. strictipes* and *G. hispidissimum*). The stipules of *G. wardii* are ovate with an obtuse apex and resemble those of *G. nakaoanum*, *G. polyanthes*, and *G. umbelliforme*; in *G. strictipes* and *G. hispidissimum* the stipules are lanceolate.

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- Xiangko Exp. 243 (5).
- Yon, B. 192 (4); 426 (1); Y  , T. T. 1541 (6); 6670 (5); 7491 (5); 15323 (5); 19713 (1); 22528 (1).
- Zhang, A. 100312 (5); Zhong Dian Exp. 606 (5).

Appendix 1. Index of collectors.

Collections are listed alphabetically by first collector's last name. Numbers in parentheses refer to the corresponding species in the text.

Ald  n, B. et al. 1268 (5); Alpine Garden Soc. Exp. 247 (5); Anderson, M. 6 (1); Anderson, T. 412 (1).